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Area Source Emission Inventory for York County South Carolina

Engineering-Science, Inc, McLean, VA

Prepared for

South Carolina State Dept of Health and Environmental Control, Columbia

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Area Source Emission Inventory for York County, South Carolina

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An area source emission inventory for York County, South Carolina was developed. All five criteria pollutants were inventoried: particulate, sulfur dioxide, hydrocarbons, carbon monoxide, and oxides of nitrogen. Estimates were made for the baseline year, 1976, and projected to two future years: 1980 and 1985.

In developing the inventory, fuel usage, solvent usage and petroleum marketing were surveyed. Procedures outlined in EPA's Guidelines for Air Quality Maintenance Planning and Analysis were used. In addition, Mobile 1, the new EPA computer program for calculating the motor vehicle emission factors for carbon dioxide, hydrocarbons, and oxides of nitrogen, was used.

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and

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and Environmental Control
Bureau of Air Quality Control

Submitted by

Engineering-Science, Inc.
7903 Westpark Drive
McLean, Virginia 22101

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CHAPTER I

INTRODUCTION

Engineering-Science is under a continuing contract to the Environmental Protection Agency (EPA), Region IV, to assist the South Carolina Department of Health and Environmental Control (DHEC) to analyze air quality maintenance. There are two designated air quality maintenance areas (AQMAs) in South Carolina consisting of portions of Greenville County (The Greenville urban area) and Berkeley and Charleston Counties (the Charleston urban area), respectively. Earlier reports under this contract discussed the analyses for these AQMAs. A later report covered the analysis for Georgetown County which although not an AQMA has a particulare ambient air quality standard attainment problem. This report documents the analysis for York County.

York County has not been designated an AQMA. The State of North Carolina, however, has designated Mecklenburg County (Charlotte) which is in the same air quality control region (AQCR) as York. Moreover, York County because of its proximity and accessibility to the Charlotte metropolitan area is likely to experience substantial growth during the next decade. After discussion with DHEC and EPA, it was decided that air quality maintenance in York County should be analyzed. In response to the requirements of the 1977 Amendments to the Clean Air Act, York County was designated as a non-attainment area for photochemical oxidants. In addition, the city of Rock Hill was designated as a non-attainment area for carbon monoxide.

REVIEW OF AIR QUALITY

Air quality data for 1976 are presented in Table I-1. As can be seen from this table, no primary ambient air quality standards for particulate, sulfur dioxide, and oxides of nitrogen are currently being violated at any of the four monitoring sites in York County. Figure I-1 presents the trend in particulate concentrations for the 1971-75 period. In general, air quality

TABLE I-1

1976 AIR QUALITY IN YORK COUNTY

(MICROGRAMS/CUBIC METER)

STATION	PARTICULATE		SO_2		NITROGEN OXIDES
	SECOND HIGHEST 24-HR MAX [1]	ANNUAL AVG [2]	SECOND HIGHEST 24-HR MAX [3]	ANNUAL AVG [4]	ANNUAL AVERAGE [5]
Bethel Fire Station	131	51	28	6	15
Rock Hill Water Treatment Plant	188	54	34	15	42
Rock Hill City Hall	90	47	54	10	35
York	114	45	41	8	18

1 Not to exceed 260 $\mu g/m^3$ more than once per year.

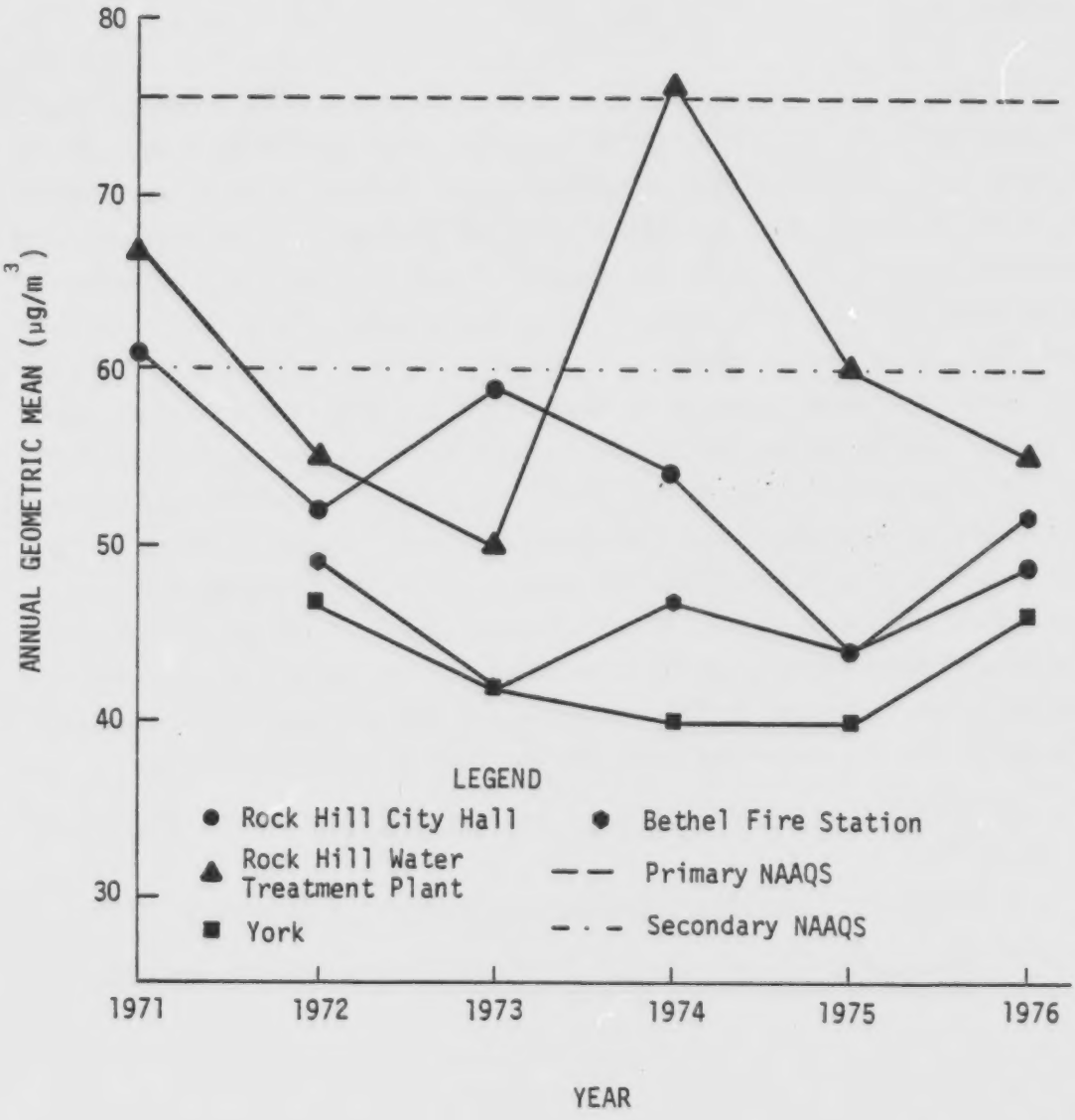
2 Annual geometric mean not to exceed 80 $\mu g/m^3$.

3 Not to exceed 365 $\mu g/m^3$ more than once per year.

4 Annual arithmetic mean not to exceed 80 $\mu g/m^3$.

5 Annual arithmetic mean not to exceed 100 $\mu g/m^3$.

Figure I-1. Particulate air quality trends in York County.



at most sites, with the possible exception of the Rock Hill Water Treatment Plant, has been improving over this period. However, the oxidant standard (160 $\mu g/m^3$ not to be exceeded more than once a year) was exceeded 79 times during 1976 and 24 times during 1975 at the Rock Hill Water Treatment Plant site. The carbon monoxide 8-hr. standard (10 milligrams per cubic meter not to be exceeded more than once a year) was exceeded once during 1976 at the Water Treatment Plant.

METHODOLOGY

After considering the results of the DHEC monitoring program, it was decided that for those pollutants amenable to dispersion modeling, particulates and sulfur dioxide, and hydrocarbons to group area source categories into general classes in accordance with methodology of treatment and type of category. These classes of area source categories are fuel combustion, transportation, fugitive dust sources, evaporative losses, and miscellaneous sources. Those source categories included in the miscellaneous class were estimated in a more expeditious manner than the categories in the other classes. These categories include on-site incineration, open burning, agricultural burning, slash burning, frost control, construction equipment, agricultural equipment, small gasoline engines, structural fires, forest fires, and prescrubed burning. If data to estimate the emissions were available, they were used. If not, a lower level of estimation was used. Throughout the project, wherever possible and to the degree possible, the instructions contained in EPA documents and publications were followed. The basic EPA documents and publications used were the following:

- Compilation of Air Pollutant Emission Factors, AP-42 (Supplement No. 7).
- Guide for Compiling a Comprehensive Emission Inventory, APTD-1135.
- Guidelines for Air Quality Maintenance Planning and Analysis, Volume 7: Projecting County Emissions.

- o Guidelines for Air Quality Maintenance Planning and Analysis, Volume 13: Allocating Projected Emissions to Sub-County Areas.
- o 40 CFR 51. Maintenance of National Ambient Air Quality Standards.

CHAPTER II

PLANNING DATA

Planning data, especially population, employment and land use data, are used to estimate county-wide emissions from certain area source categories, to allocate county-wide emissions to sub-county areas and to project baseline estimates to the planning years. Because of the importance of these data and of the need to coordinate with the various planning agencies in York County to ensure that the most recent, accurate and adequate data available were used, this chapter discusses population, employment and land use data. The chapter, also, contains a description of the grid system because the planning data determine to a large extent the grid system adopted. In succeeding chapters, the use of the planning data presented here, is duscussed separately for each area source category.

POPULATION

Baseline year and projected population estimates were provided by the York County Planning and Building Department (YCPBD). These data are given in Table II-1. Figure II-1 shows the county census divisions and the enumeration districts for which data were provided. The Division of Research and Statistical Services (DRSS) in A Forecast to 1985: The York Economy presented population projections. The two sets of projections are compared in Table II-2. As can be seen by this comparison, YCPBD projects a slower growth rate than DRSS until the late 1970's when the rate increases. The 1975 provisional population estimate for York County from the South Carolina Statistical Abstract is 92,800. The YCPBD projections are more conservative, i.e., the emission estimates will be larger if they are used, than those of the DRSS.

TABLE II-1

POPULATION PROJECTIONS FOR YORK COUNTY
BY CENSUS DIVISIONS AND ENUMERATION DISTRICTS

CENSUS DIVISION	ENUMERATION DISTRICT	1970	1976	1980	1985
Catawba-Leslie	ED 38	2,187	2,361	2,475	2,640
	ED 39	2,043	2,205	2,312	2,466
	ED 40	1,073	1,155	1,213	1.294
TOTAL		5,303	5,721	6,000	6,400
Clover East	ED 1	856	1,010	1,112	1,308
	ED 2	360	424	468	548
	ED 3	688	812	894	1,051
	ED 4	1,792	2,112	2,326	2,743
TOTAL		3,696	4,358	4,800	5,650
Clover West	ED 8	1,449	1,514	1,557	1,617
	ED 9	974	1,016	1,043	1,083
TOTAL		2,423	2,530	2,600	2.700
Clover	ED 5	1,187	1,206	1,219	1,270
	ED 6	1,102	1,120	1,132	1,179
	ED 7	1,217	1,236	1,249	1.301
TOTAL		3,506	3,562	3,600	3,750
Fort Mill	ED 25	754	782	802	961
	ED 26	1,158	1,203	1,234	1,479
	ED 27	485	504	517	619
	ED 28	643	667	684	820
	ED 29	582	603	619	742
	ED 30	74	77	80	95
	ED 31	653	678	695	833
	ED 32	156	163	168	201
	ED 33	569	987	1,265	1,419
	ED 34	1,019	1,766	2,265	2,543
	ED 35	987	1,710	2,193	2,458
	ED 36	1,291	2,240	2,874	3,221
	ED 37	586	1,014	1,301	1,459
TOTAL		8,957	12,394	14,700	16,850
Hickory Grove	ED 88	85	94	100	100
	ED 89	377	391	400	400
	ED 90	268	287	300	300
	ED 91	918	870	846	806
	ED 92	1,348	1,311	1,254	1,194
TOTAL		2,996	2,953	2,900	2,800

TABLE II-1 (Continued)

POPULATION PROJECTIONS FOR YORK COUNTY

BY CENSUS DIVISIONS AND ENUMERATION DISTRICTS

CENSUS DIVISION	ENUMERATION DISTRICT	1970	1976	1980	1985
McConnels	ED 86	213	205	200	200
	ED 87	1,030	952	900	850
TOTAL		1,243	1,157	1,100	1,050
Rock Hill	ED 41	0	0	0	0
	ED 42	105	108	113	120
	ED 43	1,799	1,948	2,047	2,166
	ED 44	2,135	2,312	2,429	2,570
	ED 45	1,334	1,445	1,517	1,605
	ED 46	686	742	780	825
	ED 47	1,588	1,719	1,807	1,912
	ED 48	253	274	287	304
	ED 49	453	490	515	545
	ED 50	1,136	1,230	1,294	1,369
	ED 51	381	412	433	458
	ED 52	1,360	1,473	1,547	1,637
	ED 53	606	655	688	728
	ED 54	1,526	1,652	1,736	1,837
	ED 55	302	326	343	363
	ED 56	2,437	2,640	2,774	2,935
	ED 57	1,213	1,314	1,380	1,460
	ED 58	507	548	576	609
	ED 59	828	897	942	997
	ED 60	744	805	846	896
	ED 61	294	318	334	354
	ED 62	787	851	895	948
	ED 63	1,572	1,704	1,790	1,895
	ED 64	1,404	1,521	1,599	1,693
	ED 65	604	653	686	727
	ED 66	872	944	992	1,051
	ED 67	855	925	972	1,029
	ED 68	1,581	1.714	1,801	1,906
	ED 69	849	918	965	1,022
	ED 70	1,147	1,243	1,307	1,384
	ED 71	1,292	1,398	1.469	1,555
	ED 72	915	991	1,041	1,102

TABLE II-1 (Continued)

POPULATION PROJECTIONS FOR YORK COUNTY

BY CENSUS DIVISIONS AND ENUMERATION DISTRICTS

CENSUS DIVISION	ENUMERATION DISTRICT	1970	1976	1980	1985
Rock Hill (Cont.)	ED 73	2,021	2,189	2,301	2,435
	ED 74	254	274	288	306
	ED 75	0	0	0	0
	ED 76	6	6	6	7
TOTAL		33,846	36,639	38,500	40,750
Rock Hill North	ED 18	222	265	294	315
	ED 19	949	1,135	1,259	1,347
	ED 20	1,212	1,447	1,605	1,718
	ED 21	301	360	400	428
	ED 22	2,158	2,579	2,859	3,059
	ED 23	1,621	1,936	2,148	2,298
	ED 24	1,083	1,294	1,435	1,535
TOTAL		7,546	9,016	10,000	10,700
Rock Hill South	ED 77	286	307	322	345
	ED 78	1,252	1,347	1,411	1,513
	ED 79	278	299	314	336
	ED 80	500	538	564	604
	ED 81	1,292	1,389	1,453	1,556
	ED 82	120	130	136	146
TOTAL		3,728	4,010	4,200	4,500
Rock Hill West	ED 83	875	960	1,016	1,088
	ED 84	860	942	998	1,069
	ED 85	74	81	86	93
TOTAL		1,809	1,983	2,100	2,250
York	ED 10	1,456	1,530	1,578	1,678
	ED 11	1,325	1,389	1,433	1,524
	ED 12	1,438	1,509	1,556	1,655
	ED 13	862	905	933	993
	ED 14	1,330	1,317	1,309	1,375
	ED 15	1,236	1,224	1,216	1,277
	ED 16	1,298	1,286	1,286	1,350
	ED 17	1,218	1,205	1,189	1,248
TOTAL		10,163	10,365	10,500	11,100
COUNTY TOTAL		82,216	94,688	101,000	108,500

Figure II-1. YORK COUNTY

CENSUS BOUNDARIES

THIS MAP WAS PREPARED BY THE
CATAWBA REGIONAL PLANNING COUNCIL
JULY 1974

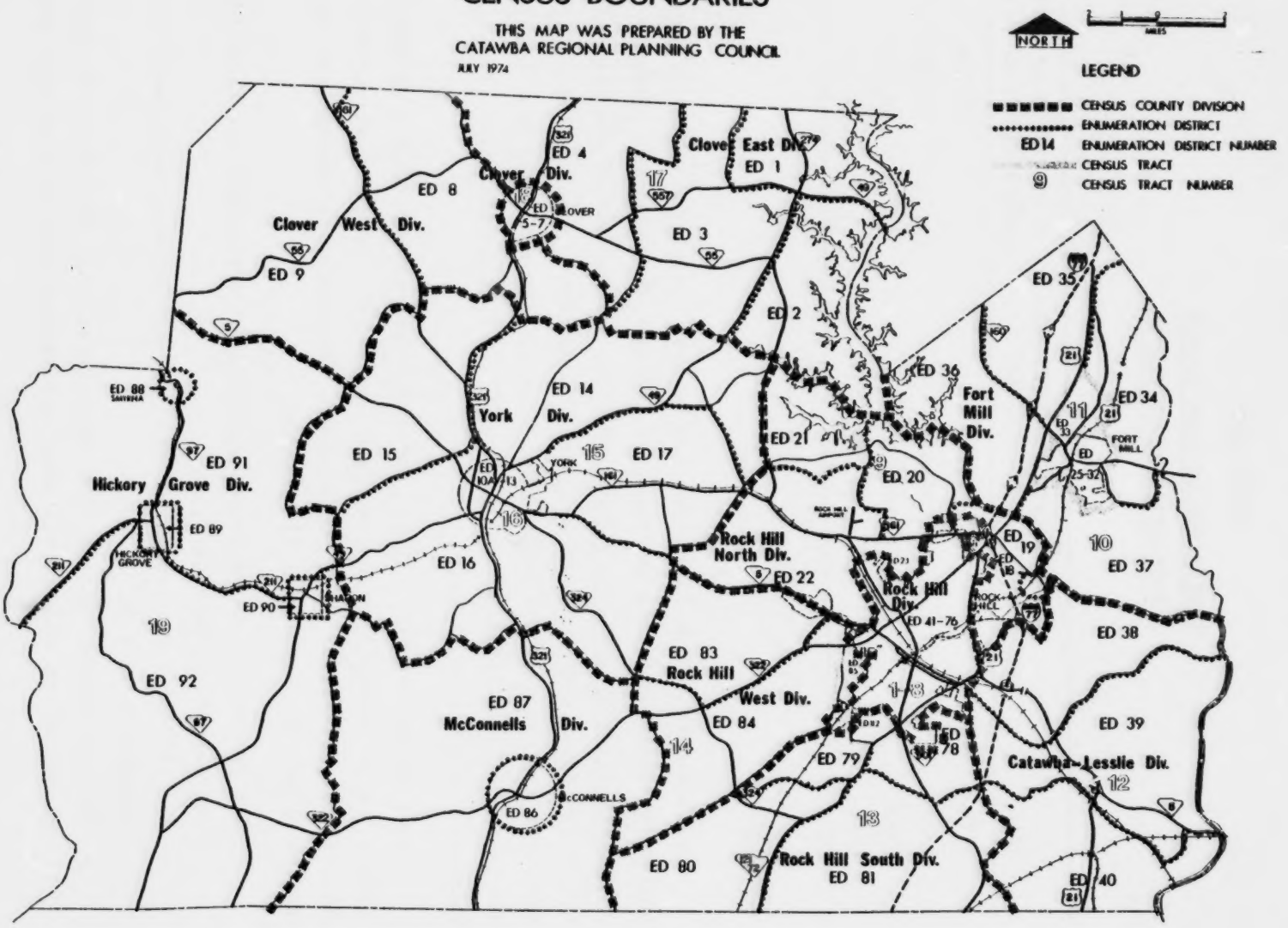


TABLE II-2

COMPARISON OF YORK COUNTY
POPULATION PROJECTIONS

YEAR	YORK COUNTY PLANNING AND BUILDING DEPARTMENT	DIVISION OF RESEARCH AND STATISTICAL SERVICES
1975	93,154	96,300
1976	94,688	96,900
1980	101,000	99,000
1985	108,500	102,800

EMPLOYMENT

Because many source categories can be best correlated with the number of employees, employment data are the best indicators of economic growth. A Forecast to 1985: The York Economy provides projections of employment for the seven common categories of employees: Government; Contract Construction; Manufacturing; Wholesale-Retail Trade; Finance, Insurance and Real Estate; Service; and Transportation, Communication and Public Utilities. Table II-3 summarizes these projections.

These employment projections were discussed with the DRSS. Because of changes due to the 1975 recession, DRSS suggested a number of adjustments which should be made to these projections. The following assumptions were used to adjust the employment projections:

- The growth rate in total non-agricultural employment for 1976-1977 was assumed to be 4.0%.
- For 1977-1978 the growth in total non-agricultural employment was assumed to be 3.0%.
- The same growth rate in total non-agricultural employment as predicted by the econometric model was assumed from 1978 through 1985.

- o The growth in manufacturing employment was assumed to be the same as that predicted by the model.
- o For new non-manufacturing employees, the same percentage of the total non-agricultural employment as predicted by the model was used.

Based upon these assumptions, the York County employment projections were modified. The modified employment projections are shown in Table II-4.

TABLE II-3

YORK COUNTY EMPLOYMENT PROJECTIONS

EMPLOYMENT CATEGORY	1976	1980	1985
Government	5,050	5,600	6,650
Contract Construction	1,200	1,900	2,300
Manufacturing	15,600	16,750	17,050
Wholesale-Retail Trade	4,950	5,650	5,850
Finance, Insurance and Real Estate	900	1,250	1,600
Service	2,700	3,750	4,950
Transportation, Communication and Public Utilities	500	500	500
TOTAL	30,900	35,400	38,900

LANDUSE

The YCPBD provided a copy of the pertinent portions of the County's land development plan. The plan is currently under review and will be revised. The Rock Hill Planning Commission provided a copy of the Rock Hill Land Development Plan. Each of these plans included existing landuse as well as proposed future landuse.

TABLE II-4

MODIFIED YORK COUNTY EMPLOYMENT PROJECTIONS

EMPLOYMENT CATEGORY	1976	1980	1985
Government	5,860	6,606	7,759
Contract Construction	1,360	2,309	2,748
Manufacturing	15,600	16,750	17,050
Wholesale-Retail Trade	5,050	5,999	6,219
Finance, Insurance and Real Estate	1,150	1,624	2,008
Service	3,550	4,973	6,291
Transportation, Communication and Public Utilities	1,520	1,520	1,520
TOTAL	34,090	39,781	43,595

GRID SYSTEM

If the particulate and sulfur dioxide emissions inventory is to be modeled using the Air Quality Display Model (AQDM) or other dispersion model, the area source emissions must be allocated to a grid system. In general, the grids in such a system should be square. However, the AQDM can successfully handle non-square grids if the grids are not too different from a square, i.e., problems can arise if grids are elongated or otherwise mishappened. An advantage of using a non-square grid system is that the system can be based upon political, social, and economic jurisdictions. Because many allocation schemes use population as an allocation parameter, census divisions are a logical basis for a gridding system. Using census divisions reduces the manipulation of data that may be necessary. Based upon these considerations, a grid system was established for York County with census divisions as the fundamental unit. Table II-5 gives a list of grids with a description of each grid. In Table II-6 the population for the baseline year and for each projection year is given.

TABLE II-5

YORK COUNTY, SC MASTER GRID SYSTEM

GRID NO.	COMPOSITION
001	ED 86 (Town of McConnells)
002	Eastern Part of ED 87
003	Northern Part of ED 87
004	Southern Part of ED 87
005	ED 90 (Town of Sharon)
006	ED 89 (Town of Hickory Grove)
007	Eastern Part of ED 91
008	Western Part of ED 91
009	Northern Part of ED 92
010	Southern Part of ED 92
011	Clover Division (Town of Clover)
012	ED 9
013	ED 8
014	ED 4
015	ED 3
016	ED 2
017	ED 1
018	ED 10A, 10B, 11, 12, & 13 (Town of York)
019	ED 14
020	ED 15
021	ED 16
022	ED 17
023	ED 25, 26, 67, 28, 29, 30, 31, & 32 (Town of Fort Mill)
024	ED 33
025	ED 34

TABLE II-5 (Continued)

YORK COUNTY, SC MASTER GRID SYSTEM

GRID NO.	COMPOSITION
026	ED 35
027	ED 36
028	ED 37
029	ED 38
030	ED 39
031	ED 40
032	ED 61
033	ED 56
034	ED 62 (minus Block 209), 63, 64, & 65
035	ED 62 (Block 209), 66, 67, 68, 69, & 77
036	ED 46, 47, 48, & 49
037	ED 50, 51, 52, 53, 54, 55, & 85
038	ED 70, 71, 72, 73, & 82
039	ED 42, 43, 44, 45, 23, & 24
040	ED 18, 19, & 41
041	ED 74 (Block 101), 75, & 78
042	ED 74 (Except Block 101), & 79
043	ED 84, 76
044	ED 83
045	ED 22
046	ED 20
047	ED 21
048	ED 80
049	ED 81
050	ED 57, 58, 59, & 60

TABLE II-6

BASELINE AND PROJECTED POPULATION

FOR EACH GRID

GRID NO.	POPULATION			
	1970	1976	1980	1985
001	213	205	200	200
002	359	332	314	297
003	358	331	313	296
004	313	289	273	257
005	268	287	300	300
006	377	391	400	400
007	514	487	474	451
008	489	477	472	455
009	573	557	533	507
010	3,506	3,562	3,600	3,750
012	974	1,016	1,043	1,083
013	1,449	1,514	1,557	1,617
014	1,792	2,112	2.326	2,743
015	688	812	894	1,051
016	360	424	468	548
017	856	1,010	1,112	1,308
018	5,081	5,333	5,500	5,850
019	1,330	1,317	1,309	1,375
020	1,236	1,224	1,216	1.277
021	1,298	1,286	1,286	1,350
022	1,218	1,205	1,189	1,248
023	4,505	4,677	4,800	5,750
024	569	987	1,265	1,419
025	1,019	1,766	2,267	2,543

TABLE II-6 (Continued)

BASELINE AND PROJECTED POPULATION

FOR EACH GRID

GRID NO.	POPULATION 1970	1976	1980	1985
026	987	1,710	2,193	2,458
027	1,291	2,240	2,874	3,221
028	586	1,014	1,301	1,459
029	2,187	2,361	2,465	2,640
030	2,043	2,205	2,321	2,466
031	1,073	1,155	1,213	1,294
032	294	318	334	354
033	2,437	2,640	2,774	2,935
034	4,293	4,649	4,886	5,174
035	4,517	4,888	5,136	5,442
036	2,980	3,225	3,389	3,586
037	5,385	5,829	6,127	6,485
038	5,495	5,951	6,254	6,622
039	8,077	9,043	9,689	10,294
040	1,171	1,400	1,553	1,662
041	1,258	1,353	1,418	1,520
042	526	567	595	635
043	866	948	1,004	1,076
044	875	960	1,016	1,088
045	2,158	2,579	2,859	3,059
046	1,212	1,447	1,605	1,718
047	301	360	400	428
048	500	538	564	604
049	1,292	1,389	1,453	1,556
050	3,292	3,564	3,744	3,962
TOTAL	85,216	94,688	101,000	108,500

CHAPTER III

FUEL COMBUSTION

The combustion of fuel contributes substantially to the total emissions for each pollutant in York County. Most of these emissions are included in the point source inventory. However, there are significant emissions from area sources which burn fuel. Area source fuel combustion can be divided into three categories: residential, commercial/institutional, and light industrial. Light industrial sources are those which are so small that they are not normally included in a point source emission inventory.

FUEL SURVEY

A comprehensive fuel survey was made of all fuel dealers in York County to provide a basis for determining fuel usage by each category. A copy of the form used in the survey is shown in Figure III-1. The results of the survey are summarized in Table III-1.

TABLE III-1

SUMMARY OF FUEL SURVEY RESULTS

FUEL CATEGORY	UNIT	RESIDENTIAL	COMMERCIAL/ INSTITUTIONAL	INDUSTRIAL
Coal	tons	400	80	-
Residual Oil	1000 gals	-	-	-
Distillate Oil	1000 gals	9,499	1,058	466
Natural Gas	$10^6 ft^3$	448	1,321	1,291
Liquified Petroleum Gas	1000 gals	1,412	170	187
TOTAL(Btu)		19.4×10^{11}	14.9×10^{11}	13.7×10^{11}

Annual fuel sales for gas, oil, and coal are reported by states in U.S. Department of the Interior, Bureau of Mines, Mineral Industry Surveys (MIS) series. After first removing fuel sales from the state total which are included under specific source categories, e.g., railroad, vessel bunkering, and aircraft fuel, the remaining fuel sales were disaggregated from the state total using three disaggregation factors: population, commercial employees, and fuel

Figure III-1. Confidential fuel survey form.

THIS DATA SHEET IS FOR _____ COUNTY, STATE OF _____ CALENDER YEAR _____

COMPANY NAME: _____

ADDRESS: _____

_____

_____

TELEPHONE NO: _____

NAME OF PERSON COMPLETING THIS FORM: _____

DATE: _____

(SEE REVERSE SIDE FOR INSTRUCTIONS AND TERM DEFINITIONS.)

TYPE OF FUEL SOLD	UNITS	TYPE OF CUSTOMER				
		RESIDENTIAL	COMMERCIAL INSTITUTIONAL	INDUSTRIAL	OTHER (SPECIFY)	FUELS FOR MOTOR VEHICLES
COKE	tons					
ANTHRACITE COAL	tons					
BITUMINOUS COAL	tons					
RESIDUAL OIL	gals.					
DISTILLATE OIL	gals.					
NATURAL GAS	10^6 ft^3					
LIQUEFIED PETROLEUM GAS (LPG)	gals.					

ENTER THE % ASH & SULFUR CONTENT FOR:	RESIDENTIAL		COMMERCIAL INSTITUTIONAL		INDUSTRIAL		OTHER (SPECIFY)	
	% ASH	% SULFUR	% ASH	% SULFUR	% ASH	% SULFUR	% ASH	% SULFUR
ANTHRACITE COAL								
BITUMINOUS COAL								
RESIDUAL OIL								
DISTILLATE OIL								

IMPORTANT: PLEASE INCLUDE ONLY FUEL SOLD TO THE FINAL USER - NOT FUEL SOLD TO OTHER FUEL DEALERS WHICH WOULD BE REPORTED AGAIN BY THAT DEALER

COMMENTS:

intensive industrial employees. The industrial employees were adjusted using fuel intensity factors from Volume 7 of the Guidelines. The 1975 MIS data were used because the 1976 data were not available. The disaggregated MIS totals, then, were adjusted to account for increases in population, industrial employment, commercial/institutional employment, as well as the difference in degree heating days between the two years. The total heat value of the fuels disaggregated from the MIS was 102.6×10^{11} Btu.

The point source fuel usage was obtained from the point source inventory. It is summarized in Table III-2. The total heat value of the fuel used by the point sources is 155.4×10^{11} Btu.

An Engineering-Science program, which calculates residential fuel usage using the methodology of Volume 13 of the Guidelines, was used to obtain theoretical residential fuel usage. These results are presented in Table III-3. As can be seen from these results, the fuel survey uncovered a greater residential fuel usage than the model.

TABLE III-2

TOTAL POINT SOURCE FUEL USAGE

FUEL TYPE	UNITS	QUANTITY
Coal	tons	300,900
Residual Oil	1000 gals	35,329
Distillate Oil	1000 gals	1,279
Natural Gas	$10^6 ft^3$	2,348
Liquified Petroleum Gas	1000 gals	5,177
TOTAL (Btu)		155.4×10^{11} Btu

TABLE III-3

THEORETICAL RESIDENTIAL FUEL USAGE

FUEL TYPE	UNITS	QUANTITY
Coal	tons	3,973
Oil	1000 gals	8,789
Natural Gas	$10^6 ft^3$	552
Wood	tons	3,662
TOTAL[1] (Btu)		18.9×10^{11} Btu

[1] Does not include wood

On the basis of these analyses, it was decided to use the fuel survey results for residential and commercial/institutional fuel usage with the exception that the wood from the Volume 13 model was included with the fuel survey residential. It was, further, decided not to use a light industrial fuel usage. It is impossible to determine whether the industrial fuel reported in the survey is included in the point source usage or not.

RESIDENTIAL FUEL USAGE

The emission factors for residential fuel usage are shown in Table III-4.

TABLE III-4

EMISSION FACTORS FOR RESIDENTIAL FUEL USAGE

POLLUTANT	(LBS/TON)	DISTILLATE (LBS/1000 GALS)	NATURAL GAS (LBS/10^3FT)	LPG (LBS/1000 GALS)	WOOD (LBS/TON)
Particulate	20	2.5	10	1.9	20
Sulfur Dioxide	114[1]	71[2]	0.6	0.014	-
Hydrocarbons	20	1	8	0.7	5
Carbon Monoxide	90	5	20	1.9	120
Oxides of Nitrogen	3	18	80	7	1

[1] Assume 3% sulfur content

[2] Assume 0.5% sulfur content

Baseline Year Emission Inventory

The total county-wide emissions from residential fuel usage are shown in Table III-5.

TABLE III-5

TOTAL COUNTY-WIDE EMISSIONS FROM RESIDENTIAL FUEL USAGE

(TONS/YEAR)

POLLUTANT	COAL	DISTILLATE OIL	NATURAL GAS	LPG	WOOD	TOTAL
Particulate	4.0	11.87	2.24	1.34	36.62	56.07
Sulfur Dioxide	22.8	337.22	0.13	0.01	-	360.16
Hydrocarbons	4.0	4.75	1.79	0.49	9.16	20.19
Carbon Monoxide	18.0	23.75	4.48	1.34	219.72	267.29
Oxides of Nitrogen	0.6	85.49	17.92	4.94	1.83	110.78

Allocation of the Baseline Year Inventory

Emissions from residential fuel usage were allocated using the procedures described in Volume 13 of the Guidelines. Engineering-Science has programmed these calculations for the computer. The Volume 13 procedure assumes total fuel usage to depend upon three input parameters: heating degree days, dwelling size distribution, and fuel type distribution.

The number of heating degree days was available from the Charlotte airport. Dwelling size distribution was given in the 1970 Census of Population and Housing. The assumption was made that dwelling size distribution was unchanged between 1970 and 1976. Fuel type distribution by number of dwelling units was available from the Bureau of the Census. All of these census data were for County Census Divisions (CCDs) which consist of a number of grids.

Using these data and the appropriate emission factors, fuel usage by CCD were calculated for each fuel type. The Volume 13 output by fuel type was factored to obtain the desired county totals. The result was allocation to CCD by the Volume 13 distribution among CCDs, county totals equalling the fuel survey totals. Within a CCD, the emissions were allocated among grids by population.

County-Wide Emission Projections

The projections of emissions from residential fuel usage depends upon population increase and future fuel type and dwelling size distribution. There has been a definite decrease nationwide in the use of coal for residential heating. The National Petroleum Council estimates that coal usage will decline by two-thirds between 1970 and 1985 on a national basis. There is little hope for increased availability of natural gas or LPG. Since South Carolina has an excess in electrical generating capacity, the use of electricity for home heating should increase somewhat faster than the use of oil. Consequently, the following assumptions concerning projected fuel type distribution were made.

- Natural and LP gas usage will remain constant;
- Of the new dwelling units and dwelling units switching from coal, 60% will be heated by electricity and 40% by distillate oil;
- Residual oil usage will remain constant; and
- The use of wood as a residential fuel will remain constant.

The reasonableness of these assumptions has been confirmed by the South Carolina Office of Energy Management.

Because information is not available on changes in building size distribution, this parameter and the heating efficiency which is calculated from it were assumed to be constant. The trend seems to be toward more multi-family dwellings and increased heating efficiency. Because predicted emissions calculated using the assumption of a constant building size distribution would tend to be larger than actual emissions, errors in the emission projections caused by ignoring this trend should be conservative.

Projected emissions from burning LPG, natural gas, residual oil, coal and wood are easily calculated from the above assumptions. The projection of emissions from burning distillate oil is more complicated. The resulting projected fuel usage is shown in Table III-6. Tables III-7 and III-8 show the projected emissions.

TABLE III-6

PROJECTED RESIDENTIAL FUEL USAGE

FUEL TYPE	UNITS	QUANTITY 1980	1985
Coal	tons	328	238
Distillate Oil	1000 gals	10,255	11,143
Natural Gas	10 ft	448	448
Liquified Petroleum Gas	1000 gals	1,412	1,412
Wood	tons	3,662	3,662

TABLE III-7

TOTAL 1980 COUNTY-WIDE EMISSIONS FROM RESIDENTIAL FUEL USAGE

(TONS/YEAR)

POLLUTANT	COAL	DISTILLATE OIL	NATURAL GAS	LPG	WOOD	TOTAL
Particulate	3.28	12.82	2.24	1.34	36.62	56.30
Sulfur Dioxide	18.70	364.06	0.13	0.01	-	382.90
Hydrocarbons	3.28	5.13	1.79	0.49	9.16	19.85
Carbon Monoxide	14.76	25.64	4.48	1.34	219.72	265.94
Oxides of Nitrogen	0.49	92.30	17.92	4.94	1.83	117.48

TABLE III-8

TOTAL 1985 COUNTY-WIDE EMISSIONS FROM RESIDENTIAL FUEL USAGE

(TONS/YEAR)

POLLUTANT	COAL	DISTILLATE OIL	NATURAL GAS	LPG	WOOD	TOTAL
Particulate	2.38	13.93	2.24	1.34	36.62	56.51
Sulfur Dioxide	13.57	395.57	0.13	0.01	-	409.28
Hydrocarbons	2.38	5.57	1.79	0.49	9.16	19.39
Carbon Monoxide	10.71	27.86	4.48	1.34	219.72	264.11
Oxides of Nitrogen	0.36	100.29	17.92	4.94	1.83	125.34

Allocation of Projected Emissions

The following factors affect the allocation of residential fuel usage emissions to grids:

- o Changes in population distribution; and
- o Changes in fuel type distribution.

Changes in population distribution were determined from the projections of population by grid. (See Table II-6). Changes in fuel type distribution were calculated on the basis of the fuel switch assumptions discussed above. The following calculations were made for each grid tract:

1. The total number of dwelling units was increased in accordance with the population increase for the grid. The assumption was made that the number of persons per dwelling unit within grids would remain constant.
2. The number of new dwelling units was determined by subtracting the number of dwelling units in the baseline year from the projected number of dwelling units.
3. The total of new dwelling units was distributed between electricity and oil on the basis of the assumed 60-40 split. The new electric-heated and oil-heated units were added to the old.

After performing these calculations for each grid, a new fuel type distribution was obtained and the effects of differential population growth included. It was assumed that there would be no change in dwelling size distribution or degree heating days. The data thus developed for each projection year were input to the computerized Volume 13 method. The output was then factored to obtain the desired county totals.

COMMERCIAL/INSTITUTIONAL FUEL USAGE

The emission factors for commercial/institutional fuel usage are shown in Table III-9.

TABLE III-9

EMISSION FACTORS FOR COMMERCIAL/INSTITUTIONAL FUEL USAGE

POLLUTANT	COAL (LBS/TON)	DISTILLATE (LBS/1000 GALS)	NATURAL GAS (LBS/10 CU.FT.)	LPG (LBS/1000 GALS)
Particulate	20[1]	2	10	1.9
Sulfur Dioxide	114[2]	71[3]	0.6	0.014
Hydrocarbons	3	1	8	0.8
Carbon Monoxide	10	5	20	2
Oxides of Nitrogen	6	22	120	12

[1] Assume an ash content of 10%

[2] Assume a sulfur content of 3%

[3] Assume a sulfur content of 0.5%

Baseline Year Emission Inventory

The baseline emissions are given in Table III-10.

TABLE III-10

TOTAL COUNTY-WIDE EMISSIONS FROM COMMERCIAL/INSTITUTIONAL FUEL USAGE

(TONS/YEAR)

POLLUTANT	COAL	DISTILLATE OIL	NATURAL GAS	LPG	TOTAL
Particulate	0.8	1.06	6.60	0.16	8.62
Sulfur Dioxide	4.56	37.56	0.40	-	42.52
Hydrocarbons	0.12	0.53	5.28	0.07	6.00
Carbon Monoxide	0.40	2.64	13.21	0.17	16.42
Oxides of Nitrogen	0.24	11.64	79.26	1.02	92.16

Allocation of the Baseline Inventory

The baseline emissions were allocated to grids based upon existing land use maps obtained from the planning agencies.

County-Wide Emission Projections

County-wide emissions from commercial/institutional fuel usage were projected in accordance with commercial/institutional growth factors, derived from the projected earnings for trade, finance, insurance, and real estate, services and government. (See Table III-11 for the derivation of the C/I growth factors.) The projected fuel usage, calculated by applying the C/I growth factors, were adjusted to reflect the following assumptions concerning future fuel availability:

- o No growth in coal usage.
- o No growth in natural or LP gas usage; and
- o No change in the ratio of residual to distillate oil (not a significant factor in York County because there was no residual oil usage.)

Calculations to adjust the fuel usage projections in accordance with the fuel switch assumptions were similar to those used for residential fuel usage. The projected commercial/institutional fuel usage is shown in Table III-12 and the projected emissions in Tables III-13 and III-14.

TABLE III-11

COMMERCIAL/INSTITUTIONAL EMPLOYMENT PROJECTIONS

CATEGORY	1976	1980	1985
Trade	5,050	5,999	6,219
FIRE[1]	1,150	1.624	2,008
Services	3,550	4,973	6,291
Government	5,860	6,606	7,759
C/I TOTAL	15,610	19,202	22,277
C/I GROWTH FACTOR		1.230	1.427

[1] FIRE - Finance, Insurance, and Real Estate

TABLE III-12

PROJECTED COMMERCIAL/INSTITUTIONAL FUEL USAGE

FUEL TYPE	UNITS	QUANTITY 1980	1985
Coal	tons	80	80
Distillate Oil	1000 gals	3471	5536
Natural Gas	$10^6 ft^3$	1321	1231
Liquefied Petroleum Gas	1000 gals	170	170

TABLE III-13

TOTAL 1980 COUNTY-WIDE EMISSIONS FROM COMMERCIAL/INSTITUTIONAL FUEL USAGE

(TONS/YEAR)

POLLUTANT	COAL	DISTILLATE OIL	NATURAL GAS	LPG	TOTAL
Particulate	0.8	3.47	6.60	0.16	11.03
Sulfur Dioxide	4.56	123.22	0.40	-	128.18
Hydrocarbons	0.12	1.74	5.28	0.07	7.21
Carbon Monoxide	0.40	8.68	13.21	0.17	22.46
Oxides of Nitrogen	0.24	38.18	79.26	1.02	118.70

TABLE III-14

TOTAL 1985 COUNTY-WIDE EMISSIONS FROM COMMERCIAL/INSTITUTIONAL FUEL USAGE

(TONS/YEAR)

POLLUTANT	COAL	DISTILLATE OIL	NATURAL GAS	LPG	TOTAL
Particulate	0.8	5.54	6.60	0.16	13.10
Sulfur Dioxide	4.56	196.53	0.40	-	201.49
Hydrocarbons	0.12	2.77	5.28	0.07	8.24
Carbon Monoxide	0.40	13.84	13.21	0.17	27.62
Oxides of Nitrogen	0.24	60.90	79.26	1.02	141.42

ALLOCATION OF PROJECTED EMISSIONS

The projected emissions were allocated using projected land use maps obtained from the local planning agencies.

CHAPTER IV

TRANSPORTATION

Transportation sources are major contributors of all of the five criteria pollutants. In particular, transportation sources contribute a substantial portion of the emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen. Transportation source categories include motor vehicles, aircraft, vessels, and railroads.

MOTOR VEHICLES

Motor vehicles can be classified according to the following classes:

1. Light-duty, gasoline-powered vehicles (automobiles) (LDV);
2. Gasoline-powered, light-duty trucks (LDT);
3. Heavy-duty, gasoline-powered vehicles (HGV);
4. Heavy-duty, diesel-powered vehicles (HDV); and
5. Motorcycles (MC).

Each class has unique emission characteristics.

The emission factors for particulate and sulfur dioxide are shown in Table IV-1. Table IV-2 shows the calculations for determining the particulate emission factors for LDV and LDT. The introduction of catalytic converters on 1975 model vehicles resulted in a decrease in the particulate emission factors for LDV and LDT. Post-1975 catalyst-equipped vehicles do not emit lead which was a major constituent of the exhaust omissions from pre-1975 LDV and LDT. The equation for calculating the emission factors for these vehicles is

$$EF = [EF_{CC} \times F] + [EF_{NCC} \times (1-F)] + EF_{TW}$$

where:

EF_{CC} = the exhaust emission factor for the 1975 model year and later cars (0.05 g/mile),

EF_{NCC} = the exhaust emission factor for 1974 model and earlier cars (0.34 g/mile),

EF_{TW} = the tire wear emission factor (0.20 g/mile), and

F = the fraction of annual miles traveled by model year.

F was calculated using national average data. Tables IV-3 and IV-4 show the calculations of average number of tires for HGV and HDV. The data used in these calculations were taken from the 1972 Census of Transportation for South Carolina.

TABLE IV-1

PARTICULATE AND SULFUR DIOXIDE EMISSION FACTORS

FOR MOTOR VEHICLES
(GRAMS/MILE)

VEHICLE CLASS	PARTICULATE			SULFUR DIOXIDE		
	1976	1980	1985	1976	1980	1985
LDV[1]	0.48	0.33	0.27	0.18	0.18	0.18
LDT[1]	0.48	0.33	0.27	0.18	0.18	0.18
HGV[1]	1.29	1.29	1.29	0.36	0.36	0.36
HDV[1]	2.12	2.12	2.12	2.80	2.80	2.80
MC[2]	0.15	0.15	0.15	0.028	0.028	0.028

[1] Includes exhaust and tire wear emissions.

[2] An average of 2-stroke (38%) and 4-stroke (62%) engine emissions based upon national averages.

TABLE IV-2

CALCULATION OF LIGHT DUTY VEHICLE PARTICULATE

EMISSION FACTORS

	MODEL YEAR	AGE (YEARS)	F
For 1976:	1976	1	0.108
	1975	2	0.112
		TOTAL	0.220

EF = (0.05)(0.220) + (0.34)(1-0.220) + 0.20 = 0.48 grams/mile

TABLE IV-2 (Continued)

CALCULATION OF LIGHT DUTY VEHICLE PARTICULATE EMISSION FACTORS

	MODEL YEAR	AGE (YEARS)	F
For 1980:	1980	1	0.112
	1979	2	0.143
	1978	3	0.130
	1977	4	0.121
	1976	5	0.108
	1975	6	0.094
		TOTAL	0.708
EF = (0.05)(0.708) + (0.34)(1-0.708) + 0.20 = 0.33 grams/mile			
For 1985:	1985	1	0.112
	1984	2	0.143
	1983	3	0.130
	1982	4	0.121
	1981	5	0.108
	1980	6	0.094
	1979	7	0.079
	1978	8	0.063
	1977	9	0.047
	1976	10	0.032
	1975	11	0.019
		TOTAL	0.948
EF = (0.05)(0.948) + (0.34)(1-0.948) + 0.20 = 0.27 grams/mile			

TABLE IV-3

CALCULATION OF MEAN NUMBER OF TIRES HGV

VEHICLE TYPE	10^6 HDGVMT	NO. TIRES	10^6 TIRE-MILES
Single Unit 2-axle	537.6	6	3,225.6
Single Unit 3-axle	48.9	10	489.0
Combination 3-axle	16.7	10	167.0
Combination 4-axle	64.6	14	904.4
Combination 5-axle	29.6	18	532.8
TOTAL	697.4		5,318.8

$$\text{Mean No. Tires} = \frac{5,318.8}{697.4} = 7.63$$

TABLE IV-4

CALCULATION OF MEAN NUMBER OF TIRES HDV

VEHICLE TYPE	10^6 HDDVMT	NO. TIRES	10^6 TIRE-MILES
Single Unit 2-axle	5.4	6	32.4
Single Unit 3-axle	16.1	10	161.0
Combination 3-axle	6.3	10	63.0
Combination 4-axle	87.4	14	1,223.6
Combination 5-axle	275.4	18	4,957.2
TOTAL	390.6		6,437.2

$$\text{Mean No. Tires} = \frac{6,437.2}{390.6} = 16.48$$

On June 24, 1977, EPA issued new emission factors for motor vehicles which replace the emission factors for carbon monoxide, hydrocarbons, and oxides of nitrogen in Supplement 5 of Compilation of Air Pollutant Emission Factors (AP-42). Eventually, these factors will be published as Supplement 8 to AP-42. The changes in the emission factors and methodology are rather substantial.

The revised equation for LDV is given by

$$E = \sum_{i}^{n} CMRALUH$$

where: C = the 1975 Federal Test Procedure (FTP) mean emission factor for each model year

M = fraction of total mileage travelled by model year

R = temperature, speed and hot/cold correction factor

A = air-conditioning correction factor

L = vehicle load correction factor

U = trailer towing correction factor

H = humidity correction factor

The humidity correction factor is only used to calculate NO_x emissions because the FTP specifies a standard condition of 75 grains of water per pound of dry air. For York County, the average humidity recorded at the Charlotte, North Arolina Airport was used to determine this correction factor.

EPA's Interim Document gives a number of tables with the national age distribution of automobiles and the average miles per year travelled by cars at a particular age. The national average distribution was used to determine fraction of miles travelled by a particular age class.

The R correction factor incorporates the old correction factors for temperature, speed, and fraction of hot and cold starts. The average annual temperature recorded at Charlotte Airport was used. In the FTP, the "cold" start condition is defined as the first 505 seconds of operation after the vehicle has been allowed to "soak" for the previous 12 hours. "Hot" start is the condition in which the car is turned off after 1375 seconds of operation (505 seconds in the cold start condition and 870 in the stabilized condition), "soaked" for 10 minutes and restarted and operated for another 505 seconds. There are presently no data available to relate the FTP conditions to actual local conditions. After discussing the problem with Mr. Len Fleckenstein of EPA's Office of Transportation and Land Use Policy (OTLUP), the assumptions incorporated in Table IV-5 were developed to estimate the operating conditions on specific road classes. The South

TABLE IV-5

ASSUMPTIONS OF VEHICLE DISTRIBUTION, SPEED, AND OPERATING CONDITIONS BY GENERAL ROAD CLASSIFICATION

ROAD CLASSIFICATION	% DISTRIBUTION BY VEHICLE CLASS[1]				AVERAGE SPEED	TYPE OF OPERATION	
	LDV	LDT[2]	HGV	HDV		% COLD	% HOT
Urban - Freeways	73.1	19.9	4.6	2.4	50	10	10
Major Arterials	76.3	20.7	2.0	1.0	30	15	20
Collectors	76.3	20.7	2.0	1.0	25	20	20
Local	77.1	20.9	1.3	0.7	20	40	30
Rural - Freeways	71.6	19.4	5.9	3.1	55	10	10
Arterials and Collectors	74.7	20.3	3.3	1.7	45	20	20
Local	77.1	20.9	1.3	0.7	25	40	20

[1] - This table does not include motorcycles because their emissions were determined by another method.

[2] - LDT includes two sub-classes LDT, which are LDT with a Gross Vehicular Weight (GVW) greater than 6000 lb. but less than 8500 lb.

Carolina Department of Highways and Public Transportation (SCDHPT) data from Columbia for percent truck distribution by road class were also incorporated into Table IV-5.

The national average of vehicles equipped with air conditioning systems by model year is given by

MODEL YEAR	% EQUIPPED WITH A/C
Pre-1966	54
1966-68	66
1969-1972	75
1973-1975	81

It is likely that the local percentage of A/C-equipped vehicles in York County will be somewhat higher than these national data. Because there was no local data upon which to base an adjustment to the national averages, the national averages were used to determine the air conditioning correction factor. It was assumed that 100% of air conditioning systems will be operating on days with temperature greater than 80°F.

The composite emission factor from the FTP is based upon a single occupant of the car with a complete load of automotive fluids. Several studies by the SCDHPT indicate an average occupancy of 1.35 persons per car. The emission factors were corrected to account for an additional 45 lbs. (based upon a potential load of 500 lbs. for 4 additional passengers).

There were no data upon which to base a correction for trailer towing. Therefore, no attempt was made to correct for this variable.

The emission factor equations for light-duty trucks are similar to those for automobiles. Most of the assumptions for automobiles were also used for light-duty trucks. EPA has distinguished, however, between two weight classes: less than 6000 lbs. GVW and 6001-8500 lbs. GVW. National sales data were used to calculate emission factors for light-duty trucks, taking into account the differences between these two weight classes.

The emission factors for HGV are given by

$$E = \sum_{i}^{n} CMVP$$

where:

C = the mean emission factor determined by FTP and San Antonio Road Route methods by model year

M = the fraction of total mileage travelled by model year

V = speed correction factor

P = truck characteristic correction factor for truck weight and weight/power ratio

The nationwide fraction of gasoline-powered, HDV annual travel by model year given in the Interim Document was used.

The average speeds given in Table IV-5 were used to determine the speed correction factors.

The truck characteristic correction factor requires data on vehicle weight (actual, not registered) and the engine's cubic inch displacement. In the absence of any data upon which to make this correction, no correction for truck characteristics was made.

The methodology outlined for heavy-duty, gasoline-powered vehicles was used for HDV. The distribution of VMT between gasoline and diesel heavy-duty vehicles for South Carolina from the 1972 Census of Transportation was used.

The emission factor equation for motorcycles is comparable to that for light-duty vehicles except that no A, L, U, and H factors are included. The total number of motorcycles in York County was obtained from the State. Total VMT was the product of the number of motorcycles and 2000 miles/year/cycle (the nationwide average). The same assumptions for LDV in Table IV-5 were used to calculate the R correction factor.

A computer program was obtained from OTLUP. This program was used to calculate the emission factors for each vehicle class and each road class. Emission factors were determined for 1976 and the two projection years, 1980 and 1985. These emission factors are given in Tables IV-6 through IV-14.

TABLE IV-6

HYDROCARBON MOTOR VEHICLE EMISSION FACTORS FOR 1976[1]

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[3]	LDT_2[3]	HGV	HDV	MC	COMPOSITE[2]
Urban - Freeway	4.89	7.62	10.60	14.81	2.30	9.22	6.10
Arterial	8.33	9.18	12.65	21.09	3.23	11.35	9.03
Collector	9.26	10.18	13.95	25.44	3.72	12.68	10.07
Local	11.57	12.66	17.17	31.39	4.39	15.81	12.43
Rural - Freeway	6.77	7.49	10.43	14.70	2.25	9.08	7.49
Arterial and Collector	7.45	8.21	11.36	15.39	2.42	9.92	8.08
Local	10.34	11.33	15.44	25.44	3.72	14.03	11.08

[1] - Includes exhaust and evaporative and crankcase emissions.

[2] - Does not include motorcycles.

[3] - The national sales data were used to split LDT into its sub-classes.

TABLE IV-7

CARBON MONOXIDE MOTOR VEHICLE EMISSION FACTORS FOR 1976

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[2]	LDT_2[2]	HGV	HDV	MC	COMPOSITE[1]
Urban - Freeway	29.23	31.37	37.75	151.56	14.93	19.08	35.51
- Arterial	47.06	49.82	59.04	177.87	20.68	27.49	50.84
- Collector	59.42	62.56	73.69	214.12	24.98	33.08	63.86
- Local	89.35	93.19	108.74	272.80	31.47	46.29	93.59
Rural - Freeway	27.54	29.62	35.71	170.07	15.39	18.32	36.50
- Arterial and Collector	36.16	38.40	45.71	144.10	15.17	21.88	40.49
- Local	74.49	77.83	91.03	214.12	24.98	39.33	77.89

[1] - Does not include motorcycles.

[2] - The national sales data were used to split LDT into its sub-classes.

TABLE IV-8

OXIDES OF NITROGEN MOTOR VEHICLE EMISSION FACTORS FOR 1976

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[2]	LDT_2[2]	HGV	HDV	MC	COMPOSITE[1]
Urban - Freeway	4.78	4.73	7.40	13.58	23.26	0.16	5.86
- Arterial	4.38	4.34	6.79	11.73	18.60	0.15	4.89
- Collector	4.19	4.14	6.48	11.27	19.32	0.14	4.69
- Local	4.25	4.21	6.59	10.80	20.82	0.14	4.67
Rural - Freeway	5.11	5.05	7.91	14.04	27.11	0.17	6.55
- Arterial and Collector	4.91	4.85	7.60	13.12	20.77	0.17	5.69
- Local	4.41	4.36	6.83	11.27	19.32	0.15	4.83

[1] - Does not include motorcycles.

[2] - The national sales data were used to split LDT into its sub-classes.

TABLE IV-9

HYDROCARBON[1] MOTOR VEHICLE EMISSION FACTORS FOR 1980

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[3]	LDT_2[3]	HGV	HDV	MC	COMPOSITE[2]
Urban - Freeway	4.39	5.23	7.89	12.83	2.38	4.14	5.14
- Arterial	5.47	6.61	9.80	18.52	3.26	5.88	6.24
- Collector	6.19	7.53	11.07	22.38	3.76	6.98	7.10
- Local	8.07	9.92	14.35	28.41	4.47	9.64	9.11
Rural - Freeway	4.29	5.11	7.72	12.70	2.35	4.00	5.11
- Arterial and Collector	4.86	5.83	8.69	13.36	2.48	4.78	5.56
- Local	7.10	8.70	12.65	22.38	3.76	8.18	7.98

1 - Includes exhaust and evaporative and crankcase emissions

2 - Does not include motorcycles

3 - The national sales data were used to split LDT into its sub-classes

TABLE IV-10

CARBON MONOXIDE MOTOR VEHICLE EMISSION FACTORS FOR 1980

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[2]	LDT_2[2]	HGV	HDV	MC	COMPOSITE[1]
Urban - Freeway	21.81	27.33	34.48	149.06	11.91	13.02	29.17
- Arterial	35.32	43.49	54.42	183.33	18.27	20.08	40.82
- Collector	45.50	55.68	69.32	216.09	22.31	24.97	52.06
- Local	71.11	86.39	106.42	266.72	28.25	36.70	78.43
Rural - Freeway	20.36	25.58	32.31	159.19	11.76	12.35	29.89
- Arterial and Collector	27.62	34.23	42.76	146.58	12.53	15.64	33.40
- Local	59.31	72.26	89.08	216.09	22.31	30.77	65.37

[1] - Does not include motorcycles.

[2] - The nation sales data were used to split LDT into its sub-classes

TABLE IV-11

OXIDES OF NITROGEN MOTOR VEHICLE EMISSION FACTORS FOR 1980

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[2]	LDT_2[2]	HGV	HDV	MC	COMPOSITE[1]
Urban - Freeway	4.05	3.95	6.60	13.15	25.62	0.29	5.20
- Arterial	3.62	3.54	5.94	11.29	18.14	0.27	4.12
- Collector	3.42	3.35	5.63	10.82	18.72	0.26	3.92
- Local	3.43	3.36	5.67	10.36	20.25	0.26	3.84
Rural - Freeway	4.35	4.24	7.08	13.62	31.53	0.31	5.96
- Arterial and Collector	4.10	4.01	6.72	12.68	21.87	0.30	4.92
- Local	3.64	3.55	5.98	10.82	18.72	0.27	4.05

[1] - Does not include motorcycles

[2] - The national sales data were used to split LDT into its sub-classes

TABLE IV-12

HYDROCARBON MOTOR VEHICLE EMISSION FACTORS FOR 1985

(GRAMS/MILE)

ROAD CLASS	LDV	LDT_1[3]	LDT_2[3]	HGV	HDV	MC	COMPOSITE[2]
Urban - Freeway	1.78	2.70	3.99	7.76	1.65	1.07	2.35
- Arterial	2.43	3.82	5.45	11.81	2.54	1.70	3.06
- Collector	2.87	4.58	6.42	14.48	3.04	2.11	3.63
- Local	4.12	6.73	9.08	18.56	3.75	3.08	5.07
Rural - Freeway	1.73	2.60	3.86	7.58	1.59	1.01	2.35
- Arterial and Collector	2.11	3.25	4.67	8.18	1.76	1.31	2.66
- Local	3.50	5.65	7.71	14.48	3.04	2.54	4.28

[1] - Includes exhaust and evaporative and crankcase emissions

[2] - Does not include motorcycles

[3] - The national sales data were used to split LDT into its sub-classes

TABLE IV-13

CARBON MONOXIDE MOTOR VEHICLE EMISSIONS FACTORS FOR 1985

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1 [2]	LDT_2 [2]	HGV	HDV	MC	COMPOSITE [1]
Urban - Freeway	10.99	20.86	25.60	128.69	10.67	4.80	18.79
- Arterial	17.83	33.93	41.30	153.84	17.04	7.82	24.56
- Collector	23.38	44.43	53.71	174.34	21.13	9.95	31.60
- Local	38.45	73.12	86.58	204.62	27.26	15.02	49.04
Rural - Freeway	10.21	19.41	23.83	133.40	10.47	4.51	19.65
- Arterial and Collector	14.41	27.42	33.06	128.33	11.30	5.96	21.27
- Local	24.22	46.16	57.40	204.62	27.26	11.09	32.23

1 - Does not include motorcycles

2 - The national sales data were used to split LDT into its sub-classes

TABLE IV-14

OXIDES OF NITROGEN MOTOR VEHICLE EMISSION FACTORS FOR 1985

(GRAMS/MILE)

ROAD CLASS	VEHICLE CLASS						
	LDV	LDT_1[2]	LDT_2[2]	HGV	HDV	MC	COMPOSITE[1]
Urban - Freeway	3.04	3.47	4.62	12.30	24.60	0.53	4.17
- Arterial	2.68	3.07	4.11	10.31	16.19	0.49	3.15
- Collector	2.53	2.89	3.89	9.81	16.82	0.47	2.99
- Local	2.53	2.89	3.92	9.31	18.49	0.48	2.90
Rural - Freeway	3.28	3.73	4.96	12.80	31.55	0.57	4.91
- Arterial and Collector	3.07	3.50	4.68	11.81	20.33	0.55	3.85
- Local	2.72	3.09	4.17	9.81	16.82	0.50	3.09

[1] - Does not include motorcycles

[2] - The national sales data were used to split LDT into its sub-classes

Baseline Year Emission Inventory

The SCDHPT provided traffic flow maps for Rock Hill and the town of Clover, Fort Mill, and York. In addition, SCDHPT provided a map of York County with the traffic count data which was available. These maps contained data obtained for 1971 for the county and 1975 for the city of Rock Hill. No county-wide vehicle-miles travelled (VMT) data were available.

To obtain VMT data, the link specific VMT was determined for each road for which annual daily traffic (ADT) was available. Information from the Rock Hill Area Transportation Study (RHATS) was used to classify the roads into the classification system for which the emission factors were calculated. The 1975 RHATS update indicated that traffic volume on selected major streets had increased 77% between 1965 and 1975 or an average of 7.7% per year. This growth rate was used to adjust the measured VMT data to account for the age of the basic ADT data. Little ADT information was available from the maps for I-77 because the maps were prepared while it was being built. It was assumed that the ADT was 15,500 for the entire length of I-77. (The 1975 Rock Hill traffic flow map gave an ADT of 14,700 for a small portion of I-77.) Urban and rural areas were differentiated by classifying all roads outside of the RHATS study area as rural. Table IV-15 gives the county-wide adjusted VMT by road classification.

TABLE IV-15

COUNTY-WIDE DAILY VMT BY ROAD CLASSIFICATION

ROAD CLASSIFICATION	VEHICLE MILES TRAVELLED
Urban - Freeways	80,600
- Arterials	313,735
- Collectors	76,340
- Local	38,677
Rural - Freeways	120,900
- Arterial and Collectors	461,672
- Local	513,681
TOTAL	1,605,605

In 1976, 1666 motorcycles were registered in York County. It was assumed that each motorcycle would travel 2000 miles per year or that the total annual county-wide motorcycle VMT would be 3,332,000 vehicle-miles. This VMT was assumed to have the same distribution as the total daily VMT given in Table IV-15.

Using the VMT data in Table IV-15 and the emission factors in Table IV-1 and Tables IV-6 through IV-8, the county-wide emissions were calculated. The county-wide baseline emisssions are shown in Table IV-16.

TABLE IV-16

TOTAL COUNTY-WIDE MOTOR VEHICLE EMISSIONS

FOR 1976

(TONS/YEAR)

ROAD CLASSIFICATION	EMISSIONS TSP	SO_2	HC	CO	NO_x
Urban - Freeways	18.17	8.11	199.34	1,154.03	189.89
- Arterials	64.43	26.50	1146.97	6,431.44	616,82
- Collectors	15.68	6.44	311.23	1,965.46	143.94
- Local	7.78	3.11	194.66	1,459.18	72.62
Rural - Freeways	28.23	13.13	366.52	1,778.95	318.38
- Arterials and Collectors	98.52	42.71	1509.99	7,537.39	1056.15
- Local	103.43	41.33	2304.39	16,129.73	997.53
TOTAL	336.24	141.33	6033.10	36,456.18	3395.33

Allocation of the Baseline Year Emission Inventory

The link specific VMT was determined for each grid. The county-wide emission estimates were allocated to each grid in accordance with that grid's proportion of the VMT for a particular road class.

County-Wide Emission Projections

The VMT for the baseline year was projected to the planning years of 1980 and 1985 using the historical growth data from the 1975 RHATS update, 7.7% per

year. The projected VMT values are shown in Table IV-17. The motorcycle VMT was projected in the same fashion. Using the projected VMT data and the emission factors from Table IV-1 and Tables IV-9 through IV-14, the county-wide emissions for the projection years were determined. These estimates are shown in Tables IV-18 and IV-19.

TABLE IV-17

PROJECTED COUNTY-WIDE DAILY VMT

ROAD CLASSIFICATION	VEHICLE MILES TRAVELLED 1980	1985
Urban - Freeways	105,425	136,456
- Arterials	410,365	531,153
- Collectors	99,853	129,244
- Local	50,590	65,480
Rural - Freeways	158,137	204,684
- Arterials and Collectors	603,867	781,611
- Local	671,895	869,662
TOTAL	2,100,132	2,718,290

TABLE IV-18

TOTAL COUNTY-WIDE MOTOR VEHICLE EMISSIONS FOR 1980

(TONS/YEAR)

ROAD CLASSIFICATION	EMISSIONS TSP	SO_2	HC	CO	NO_x
Urban - Freeways	17.72	10.65	218.83	1,239.34	220.44
- Arterials	60.70	34.64	1034.86	6,752.48	679.88
- Collectors	14.78	8.42	286.58	2,095.34	157.41
- Local	7.23	4.08	186.37	1,599.22	78.12
Rural - Freeways	28.16	17.29	326.28	1,904.52	378.98
- Arterials and Collectors	95.39	55.99	1356.26	8,129.24	1194.71
- Local	96.12	54.24	2167.88	17,703.03	1094.27
TOTAL	320.10	185.31	5577.06	39,423.17	3803.81

TABLE IV-19

TOTAL COUNTY-WIDE MOTOR VEHICLE EMISSIONS FOR 1985

(TONS/YEAR)

ROAD CLASSIFICATION	EMISSIONS TSP	SO_2	HC	CO	NO_x
Urban - Freeways	19.87	13.79	129.23	1,032.19	228.90
- Arterials	66.13	44.84	655.41	5,253.40	673.16
- Collectors	16.10	10.90	189.21	1,644.68	155.48
- Local	7.81	5.28	133.91	1,293.07	76.40
Rural - Freeways	31.95	22.38	193.83	1,618.90	404.26
- Arterials and Collectors	105.56	72.47	838.10	6,693.55	1210.63
- Local	103.86	70.21	1501.29	11,289.29	1081.22
TOTAL	351.28	239.87	3640.98	28,825.08	3830.05

Allocation of the Projected Emissions

The projected emissions were allocated to grids using the assumption that the distribution of VMT by road classes will be the same as in the baseline year. This assumption is equivalent to in situ VMT growth. Although this assumption is rather gross, it should provide conservative emissions estimates for hydrocarbons and carbon monoxide. For these two pollutants, the emission factors for lower type roads, i.e., locals, are generally higher than the emission factors for higher type roads, i.e., freeways. It is likely that the VMT for higher type roads will grow faster than that for the lower type. Likewise, the historical growth rate of 7.7% per year may be much too high in light of the on-going national energy crisis.

AIRCRAFT

There is only one airport of significance in York County. The airport manager estimated that the York County airport has an average of 50 takeoffs and landings each day or 9125 landing-takeoff operations (LTOs) per year. All operations at York County airport are general aviation and can be divided into the following types of airplanes:

Single-engine piston	8212.5
Twin-engine piston	730
Business jet (two engines)	182.5

The emission factors for each of these types of airplanes are given in Table IV-20.

TABLE IV-20

EMISSION FACTORS FOR AIRCRAFT

POLLUTANT	EMISSION FACTOR (POUNDS/LTO)		
	SINGLE-ENGINE	TWIN-ENGINE	BUSINESS JET[1]
Particulate	0.02	0.04	0.11
Sulfur Dioxide	0.014	0.028	0.37
Hydrocarbons	0.40	0.80	3.6
Carbon Monoxide	12.2	24.4	15.8
Oxides of Nitrogen	0.047	0.094	1.6

[1] The business jets have two engines.

Baseline Year Emission Inventory

Using the emission factors in Table IV-20 and the data supplied by the airport manager, total county-wide emissions from aircraft were calculated. These emission estimates are shown in Table IV-21.

TABLE IV-21

TOTAL 1976 COUNTY-WIDE EMISSIONS FROM AIRCRAFT

POLLUTANT	EMISSION (TONS/YEAR)
Particulate	0.11
Sulfur Dioxide	0.14
Hydrocarbons	2.59
Carbon Monoxide	61.88
Oxides of Nitrogen	0.51

Allocation of the Baseline Year Emission Inventory

The emissions from aircraft were assigned to the grid in which the airport is located.

County-Wide Emission Projections

The airport manager estimated that operations at the airport would increase by 75% by 1980 and 150% by 1985. Based upon these projections and assuming that the mix of general aviation aircraft would be the same, the projected emissions from aircraft for 1980 and 1985 were calculated. These emission estimates are shown in Table IV-22.

TABLE IV-22

PROJECTED EMISSIONS FROM AIRCRAFT

POLLUTANT	EMISSIONS (TONS/YEAR)	
	1980	1985
Particulate	0.19	0.48
Sulfur Dioxide	0.24	0.35
Hydrocarbons	4.53	6.48
Carbon Monoxide	108.29	154.70
Oxides of Nitrogen	0.89	1.28

Allocation of the Projected Emissions

The projected emissions were assigned to the grid in which the airport is located.

VESSELS

Lake Wylie, which borders northeastern York County, is a major recreational center for boating activity. The emission factors for gasoline-powered boats from Compilation of Air Pollutant Emission Factors (EPA Publication No. AP-42) are shown in Table IV-23.

TABLE IV-23

EMISSION FACTORS FOR RECREATIONAL BOATS

POLLUTANT	EMISSION FACTOR (POUNDS/1000 GALLONS)
Particulate	Negligible
Sulfur Dioxide	6.4
Hydrocarbons	1100
Carbon Monoxide	3300
Oxides of Nitrogen	6.6

Baseline Year Emission Inventory

No data on the exact usage by boats of Lake Wylie were available. The South Carolina Department of Wildlife and Marine Resources provided boat registration data for York County and surrounding counties. The assumption was made that 90% of the boats in York and 65% of those registered in Union, Chester, and Lancaster would use Lake Wylie. Table IV-24 shows these data.

TABLE IV-24

BOAT REGISTRATION DATA AND USAGE ASSUMPTIONS

COUNTY	BOATS REGISTERED	% USING	BOATS USING
York	3,351	90	3,016
Union	916	65	595
Chester	999	65	649
Lancaster	1,374	65	893
TOTAL			5,153

Assuming that each boat consumes 160 gallons/year, then 824,480 gallons of fuel were used by boats in York County during 1976. Based upon this fuel consumption

estimate and the emission factors in Table IV-24, total baseline year emissions were calculated. These estimates are shown in Table IV-25.

TABLE IV-25

1976 EMISSIONS FROM RECREATIONAL BOATS

POLLUTANT	EMISSIONS (TONS/YEAR)
Particulate	-
Sulfur Dioxide	2.64
Hydrocarbons	453.46
Carbon Monoxide	1,360.39
Oxides of Nitrogen	2.72

Allocation of the Baseline Year Emission Inventory

The emissions from vessels were allocated to those grids bordering Lake Wylie in proportion to each grid's share of the shoreline.

County-Wide Emission Projections

Emissions from vessels were projected to increase in accordance with the population increase. The projected emissions are given in Table IV-26.

TABLE IV-26

PROJECTED EMISSIONS FROM RECREATIONAL BOATS

POLLUTANT	EMISSIONS (TONS/YEAR)	
	1980	1985
Particulate	-	-
Sulfur Dioxide	2.82	3.03
Hydrocarbons	483.69	519.61
Carbon Monoxide	1,451.08	1,558.83
Oxides of Nitrogen	2.90	3.12

Allocation of the Projected Emissions

The projected emissions were allocated in the same manner as the baseline emissions were.

RAILROADS

The emission factors for locomotives are given in Table IV-27. These factors are taken from AP-42.

TABLE IV-27

AVERAGE LOCOMOTIVE EMISSION FACTORS

POLLUTANT	EMISSION FACTOR (LBS/1000 GALS)
Particulate	25
Sulfur Dioxide	57
Hydrocarbons	94
Carbon Monoxide	130
Oxides of Nitrogen	370

Baseline Year Emission Inventory

MIS reports sales of fuel for use by railroads. Data for 1976 were not available. However, fuel use by railroads for 1975 was lower than any other year since 1971. It is believed that this decrease was due to the 1975 economic recession. Therefore, the 1974 distillate oil usage for South Carolina (479×10^3 bbls) was used. There are 96.2 miles of track in York County. If this track mileage is proportioned to the total track mileage in the state (3034 miles), the fuel usage for York County would be 638×10^3 gallons. Using this value, total baseline year emissions were estimated. (See Table IV-28)

Allocation of Baseline Year Inventory

Emissions were allocated to grids in accordance with the track mileage measured in each grid.

County-Wide Emission Projections

Data on growth in intercity rail freight traffic were provided by the Economics and Finance Department of the Association of American Railroads. The average annual growth rate for such traffic, for the period 1954 to 1974, was 2.2% for railroad ton-miles. Growth for all modes of intercity freight traffic during the same period was 3.5%. During the past two decades, the rail share of traffic decreased from 49.6% to 38.6%. This tendency toward a decreasing share of the market is expected to halt. Consequently, an annual growth rate of 3.5% was used to project emissions for York County. These projections as well as the baseline year estimates are shown in Table IV-28.

TABLE IV-28

BASELINE AND PROJECTED EMISSIONS FROM RAILROADS

POLLUTANT	EMISSIONS (TONS/YEAR)		
	1976	1980	1985
Particulate	8.58	9.78	11.28
Sulfur Dioxide	19.55	22.29	25.71
Hydrocarbons	32.24	36.75	42.40
Carbon Monoxide	44.59	50.83	58.64
Oxides of Nitrogen	126.91	144.68	166.89

Allocation of Projected Emissions

The projected emissions were allocated in the same manner as the baseline year emissions.

CHAPTER V

FUGITIVE DUST SOURCES

A significant portion of the total York County particulate emissions results from fugitive dust sources. Fugitive dust sources include unpaved roads, tilling operations, construction activity, and re-entrained dust from paved roads. Another source category, windblown dust from aggregate storage piles, is included in the point source inventory.

UNPAVED ROADS

The AP-42 emission factor (in pounds/vehicle-mile traveled) for unpaved roads is given by the formula:

$$E = (0.81s)\left(\frac{S}{30}\right)\left(\frac{365-W}{365}\right)$$

where:

s = the silt content of the road surface material in percent.

S = the average vehicle speed, and

W = the number of "wet" days, i.e., days with greater than 0.01 inches of precipitation

Substituting into this equation the following parameters appropriate to York County:

s = 20% (assumed based upon Soil Survey data)

S = 30 mph (assumed)

W = 108 (from climatological data)

$$E = 0.81 \times 20\left(\frac{30}{30}\right)\left(\frac{365-108}{365}\right) = 11.41 \text{ lbs/VMT}$$

Of the total particulate emitted, only 60% is less than 30 μm, i.e., would remain suspended. Thus, the emission factor for total suspended particulate matter is 6.85 lbs/VMT.

Baseline Year Emission Inventory

Using a county road map, 357 miles of unpaved roads were measured. The county road supervisor recommended an average value of 25 cars per day for these unpaved roads. Using these values, the total 1976 county-wide emissions were estimated to be 11,157.37 tons/year.

Allocation of the Baseline Year Inventory

The total unpaved road mileage for each grid was measured on a county road map. Emissions were allocated in accordance with the distribution of unpaved road mileage.

County-Wide Emission Projections

Although it is accepted that some of the 1976 unpaved roads will be paved by 1980 and 1985 and that little unpaved road mileage may be added to the network over this period, it is impossible at this time to estimate the decrease in unpaved road mileage. Because of the importance of this source category and the inability to make a rational judgement as to its future contribution to air quality, it is suggested that emissions be projected as unchanging and that the effect of paving specific road sections be considered during the development of control strategies.

Allocation of Projected Emissions

As discussed above, emissions from this source category were not changed from the baseline year allocation.

TILLING ACTIVITY

The emission factor (in pounds/acre tilled) for tilling activity from AP-42 is given by the equation:

$$E = \frac{1.4s}{(PE/50)^2}$$

where

s = the silt content in percent, and

PE = the Thornthwaite Precipitation-Evaporation Index

Using the parameters appropriate to York County:

s = 27% (based upon an analysis of data from the Soil Survey)

PE = 97 (from AP-42)

$$E = \frac{1.4(27)}{(97/50)^2} = 10.04 \text{ pounds/acre}$$

Of the total particulate emitted, only 80% will remain suspended. Thus, the emission factor for total suspended particualte matter is 8.03 lbs/acre.

Baseline Year Emission Inventory

The county extension agent provided data on cropland harvested and the number of times per year each crop is tilled. These data are presented in Table V-1.

TABLE V-1

ACRES TILLED IN YORK COUNTY

	CROPLAND (ACRES)	TIMES TILLED	TILLED ACRES
Corn	2,797	5	13,985
Sorghums	1,061	3	3,183
Wheat	1,174	3	3,522
Soybeans	5,233	5	26,165
Hay	6,712	3	20,136
Cotton	4,956	8	39,648
Irish Potatoes	10	5	50
Vegetables	183	5	915
Orchards	723	1	723
TOTAL	22,849		108,327

Based upon these data, total suspended particulate emissions from tilling activity for 1976 was 434.95 tons/year.

Allocation of the Baseline Year Inventory

Tilling activity emissions were allocated in accordance with agricultural allocation factors which were assigned subjectively using USGS maps and observed concentrations of agricultural activity. A value of 100 was assigned to the grid considered to have the greatest activity. Values from 0 to 100 were assigned to all other grids by comparing their activity with the grid having the maximum activity.

County-Wide Emission Projections

There has been a continuing decline in agricultural landuse in the United States. The 1972 OBERS projections provide projections of land used for crops

in South Carolina. These projections were used to project emissions from tilling activity. The projected emissions for 1980 were 424.35 tons/year and for 1985, 267.81 tons/year.

Allocation of Projected Emissions

Emissions from tilling activity were projected to decrease. It is anticipated that this decrease will be due to the encroachment of urban landuse upon farmland. The RHATS area defines the urbanized area of York County. Therefore, the emissions from tilling activity in those grids within the RHATS area were decreased in proportion to the baseline emissions in those grids until the projected emissions in the grids within the RHATS area were zero. Then, the emissions in the rural grids were decreased in proportion to their baseline emissions.

CONSTRUCTION ACTIVITY

AP-42 suggests an emission factor of 1.2 tons/acre/month for fugitive dust emissions from construction activity. AP-42 also gives guidance as to how this emission factor can be modified to reflect local conditions. The resulting emission factor can be expressed as:

$$E = 1.2m(1-e)\left(\frac{s}{30}\right)\left(\frac{50}{PE}\right)^2$$

where

m = number of months

e = control efficiency

s = silt content

PE = Thornthwaite Precipitation-Evaporation Index

Using parameters appropriate to York County:

m = 3 months (an average time a site is disturbed)

e = 50% (assumes an efficient watering program)

s = 27% (from Soil Survey)

PE = 97 (from AP-42)

$$E = 1.2 \times 3 \times 0.5 \times \left(\frac{27}{30}\right) \times \left(\frac{50}{97}\right)^2 \times 2000 \frac{lb}{ton}$$

$$E = 860.88 \text{ lbs/acre}$$

Baseline Year Emission Inventory

Table V-2 shows the method for calculating total acres of construction. Based upon this acreage, the total 1976 county-wide particulate emissions from construction activity were 105.56 tons/year.

Allocation of the Baseline Year Inventory

The planning agencies for York County and Rock Hill provided data from building permits. These data were used to allocate the emissions to the individual grids.

County-Wide Emission Projections

The emissions from construction activity were projected using the projections of contract construction employees for York County. In 1980, the emissions were projected to be 179.22 tons/year, and in 1985, 213.29 tons/year.

Allocation of the Projected Emissions

The projected emissions were allocated to grids in accordance with the anticipated growth in population within each grid.

RE-ENTRAINED DUST

Guideline for Development of Control Strategies in Areas With Fugitive Dust Problems (EPA Publication OAQPS No. 1.2-071) gives an emission factor formula for estimating emissions from dust re-entrained from paved roads. This formula, which is based upon preliminary data, is:

$$E = kLS\left(\frac{365-W}{365}\right)$$

where:

E = dust emission rate (grams/vehicle-mile),

k = 15×10^{-5}, an empirical proportionality factor,

L = street surface dust load in grams per curbed mile of road,

S = silt content of surface dust, and

W = number of days with 0.01 inches of rainfall or more.

The same publication suggests the following typical values which can be used in the formula:

TABLE V-2

CALCULATION OF CONSTRUCTION ACTIVITY EMISSIONS

	SC	YORK
Contract Construction Employment[1]	66,834	1436

CONTRACT VALUE (10 DOLLARS)	SC[2]	YORK[3]
Residential	675	14.50
Non-Residential	495	10.64
Non-Building	187	4.02
TOTAL	1,356	29.16

ACRES OF CONSTRUCTION	FACTOR[4]	YORK
Residential	$8A/10^6\$$	116.00
Non-Residential	$2.7A/10^6\$$	28.73
Non-Building	$25A/10^6\$$	100.50
TOTAL		245.23

[1] Source: Bureau of Census, 1973

[2] Source: Bureau of Census, unpublished 1976 data compiled by the McGraw-Hill Co.

[3] Apportioned from state totals in accordance with contract construction employment

[4] Source: Development of Emisison Factors for Fugitive Dust Sources

L = 1000 lb/curbed mile (from a study of street dust loadings in selected cities),

S = 10%, and

W = 108 (from climatological data for York County).

Using these values in the formula,

$$E = (15 \times 10^{-5})(1000)(453.6 \text{ gm/lb})(0.10)\left(\frac{365-108}{365}\right)$$

E = 4.79 grams/vehicle mile

Baseline Year Emission Inventory

Using this emission factor and the total VMT for 1976 from Table IV-15, the baseline emissions were 3094.31 tons/year.

Allocation of Baseline Year Inventory

The baseline emissions were allocated to grids in accordance with each grid's motor vehicle exhaust and tire wear emissions allocation. This method approximates an allocation based upon tire-miles.

County-Wide Emission Projections

The projected VMT from Table IV-17 were used to project re-entrained dust emissions for 1980 and 1985. The projected emissions for 1980 were 4047.36 tons/year, and for 1985, 5238.67 tons/year.

Allocation of Projected Emissions

The projected emissions were allocated in the same manner as the baseline emissions.

CHAPTER VI

EVAPORATIVE LOSSES

The class of evaporative losses includes emissions from petroleum marketing, surface coating, dry cleaning, and cut-back asphalt paving. To determine the amount of gasoline marketed, paint used, and solvent used in dry cleaning, surveys were taken in York County. Copies of the survey forms used are included as Figures VI-1 through VI-3.

PETROLEUM MARKETING

Emission factors, based on the annual throughput and the tank filling method, are found in AP-42. These factors were combined as shown in Table VI-1 to obtain a single factor.

TABLE VI-1

EMISSION FACTORS FOR GASOLINE MARKETING

EMISSION SOURCE	EMISSION FACTOR (LBS/1000 GALS) SPLASH LOADING	SUBMERGED LOADING
Storage:		
Underground tank loading	11.5	7.3
Tank breathing	1.0	1.0
Vehicle refueling:		
Vapor displacement	11.0	11.0
Spillage	0.67	0.67
TOTAL	24.17	19.97

Only $9,159 \times 10^3$ gals. of gasoline were reported in the survey. The 1974 Highway Statistics gives the total gasoline consumption rate for South Carolina as $1,604,112 \times 10^3$ gals. Factoring this figure by the rate of increase in state gasoline tax revenue, an estimate of the 1976 rate is $1,679,780 \times 10^3$ gallons. If the data on allocation to the counties of

Figure VI-1. Confidential petroleum marketing survey form.

THIS INFORMATION IS FOR _____ COUNTY, STATE OF _____ , YEAR _____

COMPANY NAME _____ NAME OF PERSON
MAILING ADDRESS _____ COMPLETING THIS FORM _____
_____
TELEPHONE NO. _____ DATE _____

PLEASE COMPLETE - INCLUDE ALL STATIONS TO WHICH YOUR COMPANY SUPPLIES GASOLINE.

NO.	STATION LOCATION	TANK CAPACITY (Gallons)	THROUGHPUT (Gallons) (To Nearest 1000)	NUMBER OF PUMPS	METHOD OF FILLING STORAGE TANKS	
					Splash	Submerged
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

COMMENTS _____
_____

NOTE: Please indicate in your comments the name and address of any jobbers you have in this county.

Figure VI-2. Confidential dry cleaning solvent usage survey form.

THIS INFORMATION IS FOR _____ COUNTY, STATE OF _____ , YEAR _____

COMPANY NAME _____
LOCATION _____
MAILING ADDRESS _____
_____
TELEPHONE NO. _____

NAME OF PERSON
COMPLETING THIS FORM _____

DATE _____

AVERAGE AMOUNT OF CLOTHES CLEANED PER WEEK _____ POUNDS

TYPE OF SOLVENT	TOTAL AMOUNT PURCHASED IN YEAR	NAME & ADDRESS OF SUPPLIER	ON-SITE STORAGE CAPACITY
Perchloro-ethylene (Gallons)			
Stoddard (Gallons)			
Other (Specify) (Gallons)			

TYPE OF VAPOR RECOVERY SYSTEM:

(Please Check One)

Water-cooled Condenser ____

Activated-carbon Adsorber ____

Other (Specify)

_____ ____

None ____

COMMENTS: _____
_____

NOTE: Please indicate in your comments if you do no dry cleaning.

Figure VI-3. Confidential automotive paint usage survey form.

THIS INFORMATION IS FOR _____ COUNTY, STATE OF _____ , YEAR _____

COMPANY NAME _____
LOCATION _____
MAILING ADDRESS _____
_____
TELEPHONE NO. _____

NAME OF PERSON
COMPLETING THIS FORM _____

DATE _____

COATING		PRIMER		REDUCER OR THINNER	
TYPE	AMOUNT USED (Gallons/Week)	TYPE	AMOUNT USED (Gallons/Week)	TYPE	AMOUNT USED (Gallons/Week)
Acrylic Enamel		Enamel Primer		Enamel Reducer	
Synthetic Enamel		Lacquer Primer		Lacquer Thinner	
Acrylic Lacquer		Other (Please Specify)		Other (Please Specify)	
Other (Please Specify)					

COMMENTS _____
_____

NOTE: If you do not paint every week, please indicate in your comments your operating schedule.

gasoline tax revenue is used to disaggregate the state total, the gasoline usage rate for York County would be 45,694 x 10^3 gals. This value was used to estimate hydrocarbon emissions with the assumption that the split between loading types would be the same as that determined in the survey. Thus, 1976 county-wide emissions from gasoline marketing were estimated to be 536.71 tons/year.

The growth in evaporative losses from gasoline marketing was projected to increase with growth in VMT. The projected 1980 emissions were 702.02 tons/year. The 1985 emissions were projected to be 908.65 tons/year.

The baseline and projected emissions were allocated to grids in accordance with the data provided in the survey. It was assumed that the sources which did not respond would be located near those which did.

SURFACE COATING

This source category considers hydrocarbon emissions from solvent evaporation resulting from surface coating operations. Two types of operation were considered: (1) automotive painting in garages and body shops and (2) trade paint application (oil-based and water-borne). Emission factors for oil-based paints are found in AP-42. Emission factors for water-borne paints can be estimated from the quantity of organic volatiles in the paint.

Manufacturing applications of surface coatings, can coating, automobile assembly, etc. were not considered. These sources should be included in the point source inventory.

Automotive Painting

The quantity of automotive paint used in York County was determined from the survey of body shops and garages. These data and the resulting hydrocarbon emissions are shown in Table VI-2.

TABLE VI-2

HYDROCARBON EMISSIONS FROM AUTOMOTIVE PAINTING

TYPE OF COATING	AMOUNT[1] (GALS/YR)	EMISSION FACTOR (LBS/TON)	EMISSIONS (TONS/YR)
Enamel	449	840	0.76
Lacquer	391	1540	1.29
Primer	392	1320	1.28
Thinner/Reducer	1036	2000	3.73
TOTAL			7.06

1 In converting these volume units to weight units, the following density factors were used:

Enamel	8.1 lbs/gal
Lacquer	8.6 lbs/gal
Enamel primer	11.0 lbs/gal
Lacquer primer	9.2 lbs/gal
Thinner and reducer	7.2 lbs/gal

Trade-Paint Application

Trade-paint application refers to paint, enamel, varnish, etc., used by individuals and contractors for exterior and interior surface coating. The National Paint and Coating Association estimated that 2.1 gallons per capita (45% water-borne and 55% oil-based) are used on a national basis.

An emission factor of 1120 lbs/ton of paint from AP-42 was used to estimate emissions from oil-based paints. The volatile section of water-borne paint is 25 to 50% (35% weighted average) by weight of the paint. Of this, 5 to 20% (15% weighted average) are volatile organics. An emission factor of 5.25% by weight of water-borne paint was used.

Using these data and a density of 8.5 lbs/gal for water-borne paint and 13.0 lbs/gal for oil-based pain, 1976 hydrocarbon emissions from trade-paint application were estimated to be 418.05 tons/year.

The total hydrocarbon emissions from surface coating (automotive and trade paint) were projected in accordance with population growth. The total emissions for 1980 were 453.45 tons/year and for 1985, 487.12 tons/year. Baseline and projected emissions were allocated in accordance with the population distribution.

DRY CLEANING

All of the dry cleaning establishments in York County were contacted during the survey. Only two failed to respond. These data are shown in Table VI-3. According to AP-42, hydrocarbon emissions can be estimated by assuming that all solvent consumed is emitted. This method was used because the dry cleaners supplied data on the amount purchased. The density of Stoddard solvent is 6.49 lbs/gal, that of perchlorethylene is 13.4 lbs/gal, and that of petroleum naphtha is 6.57 lbs/gal. Baseline year emissions were estimated to be 68.71 tons/year.

TABLE VI-3

DRY CLEANING SOLVENT USAGE

TYPE OF SOLVENT	AMOUNT (GALLONS)	EMISSIONS (TONS/YEAR)
Stoddard	5440.5	17.65
Perchlorethylene	6886	46.14
Petroleum Naphtha	1500	4.93
TOTAL		68.71

Emissions from this category were projected to increase with population growth. The 1980 emissions were 73.29 tons/year. Emissions for 1985 were 78.73 tons/year.

Baseline and projected emissions were assigned to grids in accordance with the location and solvent usage of the dry cleaners who reported in the survey.

CUT-BACK ASPHALT PAVING

DHEC obtained data on the usage of cut-back asphalt paving in York County. In 1977, 45,903 gallons were used. Usage for 1979 and 1981 were projected to be 50,493 gallons and 55,084 gallons respectively. Using straight-line interpolation and extrapolation, the usage rates for 1976, 1980, and 1985 are 43,608 gallons, 52,788 gallons, and 73,444 gallons respectively. The percentage of volatiles in the cut-back was estimated to be 30% and the density is 8.75 lbs/gal. Thus, hydrocarbon emissions for 1976 were 57.24 tons/year. The projected hydrocarbon emissions for 1980 and 1985 are 69.28 tons/year and 96.40 tons/year. Baseline and projected emissions were allocated in accordance with the number of miles of paved roads in each grid.

CHAPTER VII

MISCELLANEOUS SOURCES

Miscellaneous sources include solid waste disposal (on-site incineration, open burning, agricultural burning, slash burning, and frost control), internal combustion (construction equipment, agricultural equipment, and small gasoline engines), and wildfires (forest fires, prescribed burning, and structural fires). Because the emissions from miscellaneous sources are generally less significant than those from other classes of sources, the level of the estimates of the emissions for these sources is generally lower than that for other categories.

SOLID WASTE DISPOSAL

Solid waste disposal consists of the area source categories of on-site incineration, open burning, agricultural burning, slash burning, and frost control. The South Carolina Department of Health and Environmental Control maintains files on incinerators. These can be handled as either point or area sources. They have not been included as area sources for York County. The York County extension agent confirmed that agricultural burning, slash burning, and frost control are not practiced in York County. It is not expected that agricultural practice will change in the future.

Open Burning

Volume 7 of the Guidelines gives the following factors for estimating the amount of refuse open burned:

1. Residential - 122 tons/1000 population/year
2. Commercial/Institutional - 12 tons/1000 population/year.
3. Industrial - 160 tons/1000 manufacturing employees/year.

Using these factors, the total quantities of solid waste which were open burned in 1976 were estimated. Using population and manufacturing employment projection data from Chapter II, the total quantities of refuse open burned in 1980 and 1985 were estimated. These estimates are given in Table VII-1.

TABLE VII-1

ESTIMATES OF REFUSE OPEN BURNED

TYPE OF REFUSE SOURCE	REFUSE BURNED (TONS)		
	1976	1980	1985
Residential	11,552	12,322	13,237
Commercial/Institutional	1,136	1,212	1,302
Industrial	2,590	2,781	2,830
TOTAL	15,278	16,315	17,369

Using the emission factors from AP-42 for open burning of municipal refuse, the county-wide emissions for open burning for 1976 and the projection years were calculated. These estimates are given in Table VII-2.

TABLE VII-2

COUNTY-WIDE TOTAL EMISSIONS FOR OPEN BURNING

POLLUTANT	EMISSION FACTOR (POUNDS/TON)	EMISSIONS (TONS/YEAR)		
		1976	1980	1985
Particulate	16	122.22	130.51	138.95
Sulfur Dioxide	1	7.64	8.16	8.69
Hydrocarbons	30	229.17	244.72	260.54
Carbon Monoxide	85	649.31	693.37	738.20
Oxides of Nitrogen	6	45.83	48.94	52.10

County-wide emissions for the baseline year and for the projection years were allocated to grids in accordance with the population distribution.

INTERNAL COMBUSTION

This class of miscellaneous sources includes those source categories which encompass off-highway vehicles and small gasoline engines. The three categories

included are construction equipment, agricultural equipment, and small gasoline engines.

Construction Equipment

According to the 1974 Census of Agriculture, there were 45,312 farm tractors in South Carolina. Assuming that 20% of these burn diesel and that the average tractor consumes 1,000 gallons per year, the total diesel consumption by farm tractors would be $9,062.4 \times 10^3$ gallons. MIS for 1974 reported $17,388 \times 10^3$ gallons consumed in the state by off-highway vehicles. Thus, by subtraction, $8,325.6 \times 10^3$ gallons were consumed in the state by construction equipment. If this state-wide total is disaggregated to York County based upon York's proportion of heavy construction employment, 105,627 gallons of diesel were consumed in York for construction equipment. Proportioning this 1974 fuel consumption to 1976 based upon change in contract construction employment, the 1976 York County construction equipment fuel consumption was 68,515 gallons.

AP-42 gives emission factors for a variety of construction equipment. It also gives estimates of annual operation for each piece of equipment. Using these data, average emission factors were calculated. The total county-wide emissions were calculated for 1976 and projected to 1980 and 1985 based upon growth in contract construction employment. Table VII-3 gives the county-wide emissions estimates for all three years.

TABLE VII-3

TOTAL COUNTY-WIDE EMISSIONS FOR CONSTRUCTION EQUIPMENT

POLLUTANT	EMISSION FACTOR (LB/1000 GALS)	EMISSIONS (TONS/YEAR)		
		1976	1980	1985
Particulate	24.35	0.83	1.41	1.68
Sulfur Dioxide	31.17	1.07	1.82	2.16
Hydrocarbons	29.24	1.00	1.70	2.02
Carbon Monoxide	91.16	3.12	5.30	6.30
Oxides of Nitrogen	419.32	14.36	24.38	29.02

These total county-wide emissions estimates were allocated to grids in the same manner as emissions from construction activity (Chapter V).

Agricultural Equipment

According to the 1974 Census of Agriculture, there were 945 tractors in York County. The county extension agent confirmed this number and estimated that 80% were gasoline and that average annual fuel consumption by tractor would be 650 gallons. Based upon these data and the emission factors in AP-42, total county-wide emissions from gasoline and diesel farm tractors were estimated for 1976. The 1972 OBERS Series E projections provide projections of total state cropland. These projections were used to project emissions from farm tractors to 1980 and 1985. The emissions estimates for all three years are shown in Tables VII-4 and VII-5.

TABLE VII-4

TOTAL COUNTY-WIDE EMISSIONS FROM GASOLINE FARM TRACTORS

POLLUTANT	EMISSION FACTOR (LBS/1000 GALS)	EMISSIONS (TONS/YEAR)		
		1976	1980	1985
Particulate	8.00	1.97	1.92	1.21
Sulfur Dioxide	5.31	1.30	1.27	0.80
Hydrocarbons	203.02	49.88	48.66	30.71
Carbon Monoxide	3,260	800.98	781.45	493.19
Oxides of Nitrogen	151	37.10	36.20	22.84

TABLE VII-5

TOTAL COUNTY-WIDE EMISSIONS FROM DIESEL FARM TRACTORS

POLLUTANT	EMISSION FACTOR (LBS/1000 GALS)	EMISSIONS (TONS/YEAR		
		1976	1980	1985
Particulate	45.7	2.81	2.74	1.73
Sulfur Dioxide	31.2	1.92	1.87	1.18
Hydrocarbons	60.7	3.73	3.64	2.30
Carbon Monoxide	119	7.31	7.13	4.50
Oxides of Nitrogen	335	20.58	20.08	12.67

Emissions from agricultural equipment were allocated to grids using the same procedure as that used to allocate emissions from tilling operations (Chapter V).

Small Gasoline Engines

APTD-1135 suggests a per capita usage rate of 13 gallons per year of gasoline for small gasoline engines. AP-42 presents emission factors for these engines. By comparing these emission factors, a usage rate can be determined for each type of engine, as follows:

1. 2-stroke engine = 20.6 gals/year
2. 4-stroke lawn and garden engines = 10.7 gals/year
3. 4-stroke miscellaneous engines = 12.3 gals/year

It appears from these data, that the value of 13 gallons per year from APTD-1135 may be an average usage rate per engine rather than per capita. If that is the case, the 1976 fuel usage for York County would be 258.5×10^3 gals based upon the AP-42 estimate that there are 44 million such engines in the United States. This approach appears to be more logical than using 13 gals/person/year. AP-42 also states that 90% of the engines are used for lawn and garden purposes. Given these facts, simultaneous equations can be solved to determine the percentage of each type of engine.

Based upon these assumptions, average emission factors were calculated for small gasoline engines. The total 1976 emissions were calculated. The emissions for 1980 and 1985 were determined based upon the assumption that growth in emissions will be proportional to population growth. These emission estimates are shown in Table VII-6.

TABLE VII-6

TOTAL COUNTY-WIDE EMISSIONS FROM SMALL GASOLINE ENGINES

POLLUTANT	EMISSION FACTOR (LBS/1000 GALS)	EMISSIONS (TONS/YEAR)		
		1976	1980	1985
Particulate	16.27	2.10	2.24	2.41
Sulfur Dioxide	4.96	0.64	0.68	0.73
Hydrocarbons	613.44	79.29	84.58	90.86
Carbon Monoxide	3,811.15	492.59	525.43	564.44
Oxides of Nitrogen	39.83	5.15	5.49	5.90

The baseline year and projected emissions were allocated to the grids based upon the population distribution.

WILDFIRES

This class of miscellaneous sources includes forest fires, prescribed burning, and structural fires.

Forest Fires

The South Carolina State Commission of Forestry reported 45 forest fires in York County in 1976 with 81.8 acres burned and 24 brush fires with 77.7 acres of fields burned. AP-42 presents emission factors in terms of pounds per ton of fuel consumed. For the Southeast, a typical value for fuel availability (from AP-42) is nine tons per acre. It was assumed that half of this amount would be available on brushland. Thus, 120.65 acres of equivalent forest land were burned. Using these assumptions, the total 1976 county-wide emissions from forest fires were estimated.

Forest fires by their nature are difficult to predict. The incidence of forest fires should be proportional, however, to the amount of forest land. The 1972 Series E OBERS provided projections of commercial forest area for South Carolina. These projections were used to estimate forest fire emissions for 1980 and 1985. The total county-wide emissions estimates for 1976, 1980, and 1985 are given in Table VII-7.

TABLE VII-7

TOTAL COUNTY-WIDE EMISSIONS FROM FOREST FIRES

POLLUTANT	EMISSION FACTOR (LBS/ACRE)	EMISSIONS (TONS/YEAR)		
		1976	1980	1985
Particulate	153	9.23	8.19	7.92
Sulfur Dioxide	Negligible	-	-	-
Hydrocarbons	216	13.03	11.57	11.18
Carbon Monoxide	1,260	76.01	67.46	65.23
Oxides of Nitrogen	36	2.17	1.93	1.86

Forest fire emissions for the baseline and projection years were allocated in accordance with forest land allocation factors assigned subjectively using USGS maps and observed concentrations of forest land. Values from 0 to 100 were assigned to all other grids by comparing their forest land area with that of the grid assigned the maximum value.

Prescribed Burning

Prescribed burning is a common practice in much of South Carolina. In 1976, 30 acres were burned during two burns. Prescribed burning is used to limit the amount of available forest fuels to control damage from any subsequent wildfires, to control diseases such as brownspots, and to control hardwoods in pine stands.

AP-42 does not specifically address the problem of estimating emissions from prescribed burns. It was assumed that only one-third of the normally available fuel would be burned. Using this assumption and the AP-42 emission factors for forest fires, total 1976 county-wide emissions from prescribed

burning were estimated. The same projection procedure outlined for forest fires was used for prescribed burning. The emission estimates for all three years are given in Table VII-8.

TABLE VII-8

TOTAL COUNTY-WIDE EMISSIONS FROM PRESCRIBED BURNING

POLLUTANT	EMISSION FACTOR (LBS/ACRE)	EMISSIONS (TONS/YEAR)		
		1976	1980	1985
Particulate	51	0.76	0.67	0.65
Sulfur Dioxide	-	-	-	-
Hydrocarbons	72	1.08	0.96	0.93
Carbon Monoxide	420	6.30	5.59	5.41
Oxides of Nitrogen	12	0.18	0.16	0.15

These emissions were allocated to grids using the same procedure outlined above for forest fires.

STRUCTURAL FIRES

The average per capita loss from fire in 1974 was 15.09 dollars. The median value of a house in 1974 was $27,200. Using these data, an estimate was made of the number of equivalent houses in York County in 1974 that were burned, i.e., 51 houses. An average 1500 sq.ft. dwelling contains 16.8 tons of wood. If four tons are added for furnishings, the total amount of fuel burned by structural fires in 1974 was 1060.8 tons. To obtain a value for 1976, this value was projected to increase with population. The estimate for 1976 was 1097.4 tons. Using this value and the emission factors from AP-42, the baseline year emissions were calculated. The emissions for 1980 and 1985 were obtained by projecting the baseline emissions in accordance with population. Baseline and projected emissions are shown in Table VIII-9.

TABLE VII-9

BASELINE AND PROJECTED EMISSIONS FROM STRUCTURAL FIRES

POLLUTANT	EMISSION FACTOR (LBS/TON)	EMISSIONS (TON/YEAR)		
		1976	1980	1985
Particulate	17	9.33	9.95	10.69
Sulfur Dioxide	neglible	-	-	-
Hydrocarbons	4	2.19	2.34	2.51
Carbon Monoxide	50	27.44	29.27	31.44
Oxides of Nitrogen	2	1.10	1.17	1.26

The baseline and projected emissions were allocated to grids in accordance with the population distribution.

CHAPTER VIII

EMISSIONS SUMMARY

The emissions estimates for all area source categories are summarized in Tables VIII-1 through VIII-3. Based upon the projection methodology used, area source emissions of particulates, sulfur dioxide, and oxides of nitrogen will increase between 1976 and 1985 13.8%, 54.3%, and 14.0%, respectively. Yet, area source emissions of hydrocarbons are projected to decrease by 22.5% and emissions of carbon monoxide by 18.6%.

TABLE VIII-1

SUMMARY OF AREA SOURCE EMISSIONS FOR 1976

(TONS/YEAR)

SOURCE CATEGORY	TSP	SO_2	HC	CO	NO_x
Fuel Combustion					
Residential	56.07	360.16	20.19	267.29	110.78
Commercial/Institutional	8.62	42.52	6.00	16.42	92.16
Transportation					
Motor Vehicles	336.24	141.33	6,033.10	36,456.18	3,395.33
Aircraft	0.11	0.14	2.59	61.88	0.51
Vessels	-	2.64	453.46	1,360.39	2.72
Railroads	8.58	19.55	32.24	44.59	126.91
Fugitive Dust Sources					
Unpaved Roads	11,157.37	-	-	-	-
Tilling Activity	434.95	-	-	-	-
Construction Activity	105.56	-	-	-	-
Re-Entrained Dust	3,094.31	-	-	-	-
Evaporative Losses					
Petroleum Marketing	-	-	536.71	-	-
Surface Coating	-	-	425.11	-	-
Dry Cleaning	-	-	68.71	-	-
Asphalt Paving	-	-	57.24	-	-
Miscellaneous					
Solid Waste					
Open Burning	122.22	7.64	229.17	649.31	45.83
Internal Combustion					
Construction Equipment	0.83	1.07	1.00	3.12	14.36
Agricultural Equipment	4.78	3.22	53.61	808.29	57.68
Small Gasoline Engines	2.10	0.64	79.29	492.59	5.15

TABLE VIII-1 (CONTINUED)

SUMMARY OF AREA SOURCE EMISSIONS FOR 1976

(TONS/YEAR)

SOURCE CATEGORY	TSP	SO_2	HC	CO	NO_x
Wildfires					
Forest Fires	9.23	-	13.03	76.01	2.17
Prescribed Burning	0.76	-	1.08	6.30	0.18
Structural Fires	9.33	-	2.19	27.44	1.10
TOTAL	15,351.06	578.91	8,014.72	40,269.81	3,854.88

TABLE VIII-2

SUMMARY OF AREA SOURCE EMISSIONS FOR 1980

(TONS/YEAR)

SOURCE CATEGORY	TSP	SO_2	HC	CO	NO_x
Fuel Combustion					
Residential	56.30	382.90	19.85	265.94	117.48
Commercial/Institutional	11.03	128.18	7.21	22.46	118.70
Transportation					
Motor Vehicles	320.10	185.31	5,577.06	39,423.17	3,803.81
Aircraft	0.19	0.24	4.53	108.29	0.89
Vessels	-	2.82	483.69	1,451.08	2.90
Railroads	9.78	22.29	36.75	50.83	144.68
Fugitive Dust Sources					
Unpaved Roads	11,157.37	-	-	-	-
Tilling Activity	424.35	-	-	-	-
Construction Activity	179.22	-	-	-	-
Re-Entrained Dust	4,047.36	-	-	-	-
Evaporative Losses					
Petroleum Marketing	-	-	702.02	-	-
Surface Coating	-	-	453.45	-	-
Dry Cleaning	-	-	73.29	-	-
Asphalt Paving	-	-	69.28	-	-
Miscellaneous					
Solid Waste					
Open Burning	130.51	8.16	244.72	693.37	48.94
Internal Combustion					
Construction Equipment	1.41	1.82	1.70	5.30	24.38
Agricultural Equipment	4.66	3.14	52.30	788.58	56.28
Small Gasoline Engines	2.24	0.68	84.58	525.43	5.49

TABLE VIII-2 (CONTINUED)

SUMMARY OF AREA SOURCE EMISSIONS FOR 1980

(TONS/YEAR)

SOURCE CATEGORY	TSP	SO_2	HC	CO	NO_x
Wildfires					
Forest Fires	8.19	-	11.57	67.46	1.93
Prescribed Burning	0.67	-	0.96	5.59	0.16
Structural Fires	9.95	-	2.34	29.27	1.17
TOTAL	16,363.33	735.54	7,825.30	43,436.77	4,326.81

TABLE VIII-3

SUMMARY OF AREA SOURCE EMISSIONS FOR 1985

(TONS/YEAR)

SOURCE CATEGORY	TSP	SO_2	HC	CO	NO_x
Fuel Combustion					
Residential	56.51	409.28	19.39	264.11	125.34
Commercial/Institutional	13.10	201.49	8.24	27.62	141.42
Transportation					
Motor Vehicles	351.28	239.87	3,640.98	28,825.08	3,830.05
Aircraft	0.48	0.35	6.48	154.70	1.28
Vessels	-	3.03	519.61	1,558.83	3.12
Railroads	11.28	25.71	42.40	58.64	166.89
Fugitive Dust Sources					
Unpaved Roads	11,157.37	-	-	-	-
Tilling Activity	267.81	-	-	-	-
Construction Activity	213.29	-	-	-	-
Re-Entrained Dust	5,238.67	-	-	-	-
Evaporative Losses					
Petroleum Marketing	-	-	908.65	-	-
Surface Coating	-	-	487.12	-	-
Dry Cleaning	-	-	78.73	-	-
Asphalt Paving	-	-	96.40	-	-
Miscellaneous Sources					
Solid Waste					
Open Burning	138.95	8.69	260.54	738.20	52.10
Internal Combustion					
Construction Equipment	1.68	2.16	2.02	6.30	29.02
Agricultural Equipment	2.94	1.98	33.01	497.69	35.51
Small Gasoline Engines	2.41	0.73	90.86	564.44	5.90

TABLE VIII-3 (CONTINUED)

SUMMARY OF AREA SOURCE EMISSIONS FOR 1985

(TONS/YEAR)

SOURCE CATEGORY	TSP	SO_2	HC	CO	NO_x
Wildfires					
Forest Fires	7.92	-	11.18	65.23	1.86
Prescribed Burning	0.65	-	0.93	5.41	0.15
Structural Fires	10.69	-	2.51	31.44	1.26
TOTAL	17,475.03	893.29	6,209.05	32,797.69	4,393.90